American Journal of Orthodontics and Oral Surgery

VOL. 27 APRIL, 1941 No. 4

Original Articles

NAMING DENTAL ANOMALIES: A STUDY IN ORTHODONTIC NOMENCLATURE

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THERE is little question in my mind that most of you experienced a feeling of surprise when you learned that my introduction to this program was to deal with the unsettled, contentious, and much avoided subject of "Orthodontic Nomenclature." Such a reaction would be justified, for any review of the terms used in our current literature, and the titles appearing in the programs of our meetings, will reveal a lack of uniformity and variance of meaning which is unparalleled in any other branch of science. That this situation cannot go on, if we are to enjoy an accelerated progress attainable through a common language, quickly becomes apparent to the searching mind, for this "faulty foundation stone in our professional structure" should be reconstructed and made basic to it.

The lack of any uniform plan of describing orthodontic problems may be attributed to various causes. First and foremost, we have been passing through the pioneering stages of our specialty and, therefore, while much ground has been covered, and new territories explored, the general fabric of these accomplishments has not been brought under one recognized control. You are all familiar with the old saying, "The child who is taught his religion at his mother's knee will not depart from it when he is old." This is but another way of expressing the well-known fact that man is loath to make changes, and that he will usually continue to act, to speak, and to do the ordinary things of life as he is first taught them. This principle has found its expression in our specialty where the influence of early teachers is evident, with their students still using the terms and expressions learned in their initial studies and hesitant to give them up. In some cases, this attribute has assumed a blind and almost fanatical adherence, with the result that when some intrepid soul has lifted his voice, with a suggestion for improvement, he has either been ignored or voted down by those who considered his ideas out of line.

Read before the Twentieth Annual Meeting of the Southwestern Society of Orthodontists, February 4, 1941.

Nowhere has this been better demonstrated than in the term which designates our specialty. Dr. Angle was among the very first to advance the idea that those who were to practice the science and art of correcting dental irregularities should devote themselves exclusively to this field, thereby establishing a specialty. This he designated as "orthodontia," although *the term was not originated by him, but by Lefaulon, a Frenchman, who used it in his series of articles which appeared in 1839.*[1] Ten years later, Chapin A. Harris, in his *Dictionary of Dental Science,* defined "orthodontia as that part of dental surgery which has for its object the treatment of irregularities of the teeth." Lefaulon also used the terms "orthodontosie" and "orthopedia dentaire," but voiced his disapproval of the latter term which he considered inappropriate. These early attempts to find a name for our specialty, while understandable in their implications, were evidently not based upon sound lexicography, especially if applied to the English language, *for since the fifteenth century, authorities in this field have utilized the ending ". . . ics" to denote a science,* while the ending ". . . ia" has been applied to remedies, geographic regions, certain varieties of flowers and diseases.

The Nomenclature Committee of the American Association of Orthodontists[2] had occasion to go into this matter and, among others, consulted Professor H. T. Price of the University of Michigan, also an editor of the *Oxford Dictionary.* He told us essentially what I have already stated; i.e., that the ending ". . . ia" is correct in such words as "morphia," "hydrophobia," "Persia," or in the names of flowers, such as "fuchsia," "gardenia," etc. Referring to the ending ". . . ics," he states: *"If you speak of orthodontics, I know at once you are speaking about a science and do not need to start guessing wildly in which of a half-dozen categories I must place this word."*

Sir James Murray,[3] the eminent philologist, was the first to utilize the term "orthodontics" and was doubtless impelled by the same line of reasoning which brought into being such words as "orthopedics," "obstetrics," "optics," "pediatrics," and numerous others relating to the medical and scientific field. Most orthodontists have now adopted the new term, but some still adhere to "orthodontia," perhaps through habit, or their inability to accept changes.

Any group of scientific or professional men should be meticulous in their use of terms, and in this respect few words in the past have been more abused than "orthodontia." *Whether employed as a noun, an adjective, or an adverb, the same spelling has frequently been used.* To illustrate, we have seen it used as an adjective, such as "The orthodontia section of the A. D. A.," instead of "The orthodontic section of the A. D. A." We have had "orthodontia appliances," referred to instead of "orthodontic appliances," and have noted other language abuses equally flagrant. In concluding this phase of our discussion, let us say, therefore, that, according to the best language authorities, orthodont*ics* is the science we practice, an orthodont*ist* is the practitioner of it, orthodont*ic* appliances are included in the means we employ, and if we wish to use an adverb, we may safely say that "our therapy is applied orthodont*ically.*"

Some of the faults already outlined also apply to the terms employed to describe our field of operation. The early concept of orthodontics was that it

was a tooth problem and, therefore, the term "dental irregularities" seemed adequate to describe the field embraced. Later, when Dr. Angle laid great emphasis upon the functional relationship of all the teeth, the terms "normal occlusion" and "malocclusion of the teeth" came into common usage. All too frequently this latter term has been shortened to the one word, "malocclusion," without any reference to other structures involved. Since our concept has broadened, and we realize that the abnormalities we treat may not only include individual teeth, groups of teeth, one or both dental arches, but also the maxilla, the mandible, or both, as well as important muscles related to them, the term "malocclusion of the teeth" appears inadequate, unless its meaning can rightly be extended to include a far greater range of pathologic entities. That this cannot be logically done, if the words we employ are really to describe structures and their relationships, is quickly apparent to the analytic mind, for other factors than *closure* (occlusion), and *teeth* are involved.

With the advent of "the Angle classification of malocclusion," the orthodontic field underwent a definite reorganization, and a certain degree of order replaced what had been utter chaos. This also brought new terms, some of which were helpful in that *they described relationships,* while others had *to be defined and memorized so that their meaning could be conveyed.* The terms "Class I, Class II, and Class III" were of no value to one unfamiliar with the separate definition of each, but when Lischer substituted "neutroclusion," "distoclusion," and "mesioclusion," the meaning of these three generalized types of deformity became more comprehensive.[3] The terms Angle suggested to describe the positions of individual teeth, such as "distal occlusion," "mesial occlusion," "labial occlusion," "lingual occlusion," etc., were also modified and improved by Lischer, by combining the Latin prefix indicating direction with the word "version," also of Latin derivation, which means position, thus giving us "distoversion," "mesioversion," "labioversion," "linguoversion," etc., which are not only more descriptive and euphonious, but in harmony with scientific terminology.

The incompleteness of the word "malocclusion" has already been mentioned. What shall we employ to take its place? The field which engages our efforts is now recognized, and a word in harmony with it, and expressive of the modern concept of orthodontics, is essential. Since the conditions we are called upon to treat are the result of aberrations of growth and function, a general term suitable for such conditions is desirable. *This, combined with such anatomic designations necessary to describe the structures involved, is essential to complete an understandable plan.* Several words suggest themselves, such as "abnormality," "malformation," "deformity," and "irregularity," but the word *"anomaly,"* which means *"deviating from the common rule, type, or form, an irregularity, a thing abnormal,"*[4] not only answers the requirements, but is short enough to be euphonious in its use with other terms. Thus we may have *"dental anomalies,"* or *"dental and oral anomalies," "dento-facial anomalies," "maxillary or cranial anomalies."*

Having settled upon a general term, we next come to the selection of those additional words which are essential to definite description. *To those who have*

memorized the Angle classification of malocclusion and feel that it covers the field of dento-facial anomalies, such efforts would seem futile and unnecessary. However, an appreciable number of competent investigators have shown that this classification is inadequate, for the denture is not an isolated structure, but one having many dependent relationships; *therefore, any scientific evaluation of dental, oral, or dento-facial anomalies requires that these be recognized and named where they occur,* whether they include the teeth alone, extend beyond the boundaries of the dental arches and involve the jaws, or include some of the external features of the face.

There is a general classification into which all dental and oral anomalies fall, but this must of necessity overlook all but the most obvious physical factors. We know all may be included in two definite categories; viz., first, *those where the anomaly is limited to the denture alone, which are termed "eugnathic";*[5] and second, *those where the anomaly extends beyond the denture and includes the maxilla, or the mandible, or both, which are termed "dysgnathic."* In following this plan, our descriptive words are correct, for "eu" means mild, or less severe while "gnathic" means jaw. Therefore, "eugnathic anomalies" are mild or less severe types. On the other hand, "dys" means ill, bad, or difficult; therefore, "dysgnathic anomalies" are immediately classified as those more serious and difficult. The term "gnathic" or "gnathia" may be further applied to advantage for, in the event we have a definite overgrowth of one of the jaws, such as the mandible, the terms "mandibular macrognathia" is definite in its description, "macro" meaning too large. Where the opposite condition prevails, we have a "mandibular micrognathia," the term "micro" meaning too small. If both jaws are involved, the condition would be "bimaxillary." If one side only is affected, it is "unilateral," or if both are involved, "bilateral"; if both sides are equally affected, "symmetrical," if differing, "asymmetrical." Thus it will be seen that the term "gnathia," or "gnathic" needs only a suitable prefix to describe the usual types of dental anomalies, or those where the jaws are involved, or again those where complicated pathologic overgrowth or undergrowth are factors involved. In Figs. 1, 2, and 3, are shown examples which make plain these classifications.

If we analyze the fundamental conditions manifest in the cases we treat, we will find they include *anomalies of eruption, of number, of form, of position, of tongue size, and of muscular development.* Therefore, the descriptive terms essential to meet these details of involvement are far less numerous than would ordinarily be imagined, if they are definitely and directly applied. These must fulfill the following descriptive requirements: (1) designation of individual tooth relationships; (2) designation of alterations in dental arch form; (3) designation of dental arch relationship; (4) designation of structural involvement beyond the immediate area of the denture.

Professor Simon[6] made the first attempt to accomplish this by utilizing the term "traction," with prefixes to indicate direction and the anatomic parts involved. Thus, structures too far inward (toward the median plane) are in "contraction"; too far outward, "distraction"; too far forward, "protraction"; too far backward, "retraction"; too high up in the face, "attraction," or too low in the face "abstraction." As an example of the application of these

terms, we will apply them to the case shown in Fig. 4. At the time he suggested these terms, he did not consider them beyond improvement, for he felt the question of orthodontic nomenclature an open one. His plan has not received very general approval, in spite of the fact that several competent orthodontic terminologists have felt that it possessed the desirable attributes of being brief and definite and, therefore, adequate. From others, it has received severe criticism on the ground that the basic word "traction" is incompatible with the orthodontic field. However, many of these same critics continue the use of such terms as "Class II," "posterior occlusion," "anterior

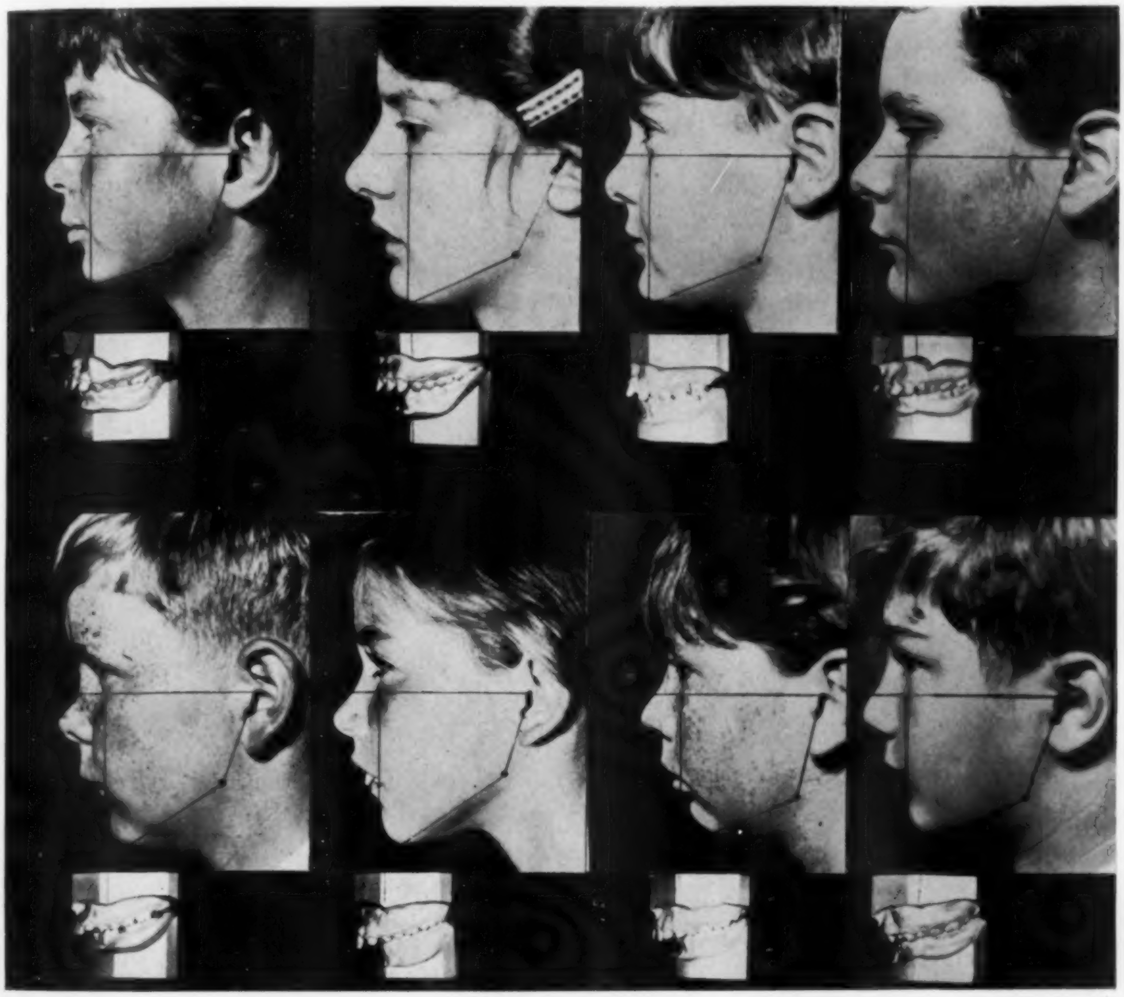

Fig. 1.—The dento-facial records in the upper row are eugnathic anomalies. In the lower row, dysgnathic anomalies are shown.

occlusion," "double protrusion," and other designations either vague or meaningless when analyzed. In connection with the last term mentioned; i.e., "double protrusion," we might infer that this means "two protrusions," and by deduction elicit that this would mean that two sets of teeth were protruding—hence the upper and lower. Simon would refer to this as a "bimaxillary protraction," which is more definite and precise. Why not call it a "bimaxillary anteversion"?

This suggests a possible means of improvement by extending the application of Professor Lischer's use of the word "version,"[7] derived from the Latin "vertere," which means to change position. In medical terminology, it has long been used in combination with other words to describe the position of the fetus in the uterus. At the time he introduced the term, he intended it to apply *to individual tooth positions only*, but I believe underestimated its value, *for when combined with the names of the structures involved, it will prove adequate in designating anomalies, not only of individual teeth, but deviations in dental arch form, alterations in dental arch relationships, and structural involvements beyond the immediate area of the denture.* This is accomplished by adding the simple Latin prefixes indicating direction. These are "intra," "extra," "ante," "retro," "supra," and "infra." Thus structures too far inward (toward the median plane) are in "*intraversion*," too far outward in "*extraversion*," too far forward in "*anteversion*," too far backward in "*retroversion*," too high up in the face in "*supraversion*," or too low in their positions

Fig. 2.—A pronounced bimaxillary macrognathia (unilateral) is shown here. It was accompanied with a definite macroglossia, also unilateral, the effect of which is evident upon the left side of the denture.

in "*infraversion*." These terms can apply to a single tooth, a group of teeth, the lateral portion of a jaw, or the whole part, and indicate conditions which may be "unilateral," or "bilateral," "symmetrical," or "asymmetrical," "maxillary," "mandibular," or "bimaxillary." As a matter of practical usage, let us apply them also to the case shown in Fig. 4.

Reference has already been made to the fact that the Nomenclature Committee of the American Association of Orthodontists has carried on consider-

Fig. 3.—A mandibular micrognathia, mild in character, is demonstrated here.

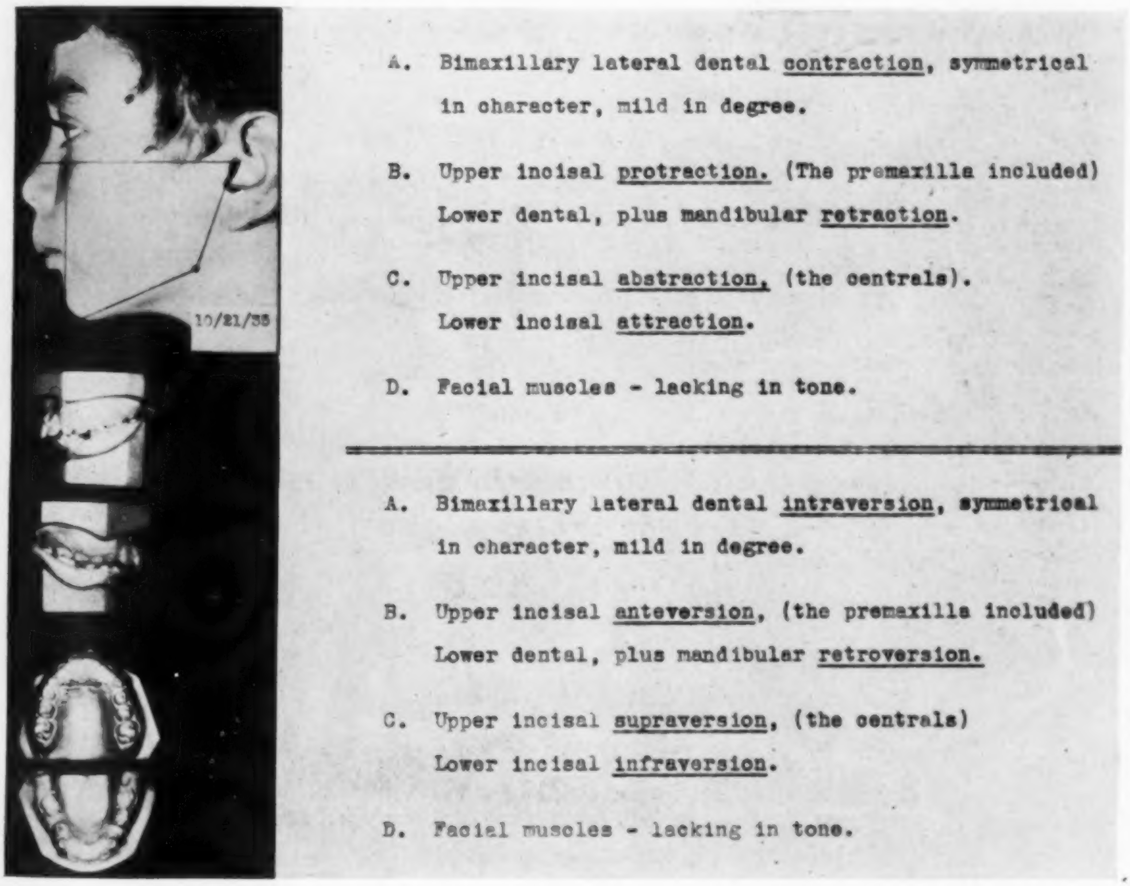

Fig. 4.—The dento-facial malrelations of this case are described by two methods. In the upper half the word "traction," with suitable prefixes is employed. In the lower, the word "version" is used in the same manner. This gives an opportunity for comparison.

able correspondence with known authorities in an effort to get somewhere with the problem of terminology. Among those consulted was the eminent Dr. E. B. Jamieson,[8] of the Anatomical Department of the University of Edinburgh, who made several very helpful suggestions. I quote from one of his letters: "I think you will have to sit down and make a list of names of all the things for which you want names. If a thing already has a name, adopt it if it is good; invent a good name if it is bad. If a thing has more than one name, choose the best; but if they are all bad, invent a good name. . . . In the case of adjectives of position, assume that the body is upright and use the ordinary adjectives whenever applicable. . . . Use "lateral" and "medial" when you mean farther from the median plane and nearer to it. . . . If you expect or hope that your nomenclature will be adopted by other countries, you will have to give a Latin translation and sometimes your choice of a name will depend on whether or not you can find a good Latin equivalent for it."

In emphasizing the necessity for words coming directly from Latin, Dr. Jamieson has stressed a very important point. The fact that all anatomic terms are rooted in this language has been largely responsible for the satisfactory status of anatomic knowledge throughout the world. The same principle has been made applicable to other sciences, and should not be overlooked by orthodontics. It may be of interest to you to realize that with all of the terms we have considered favorably so far, this requirement is fully met. If we summarize these, we have the following:

Orthodontics

A noun, indicating the science which has for its object the prevention and correction of dental and oral anomalies.

Orthodontic

An adjective, describing or referring to orthodontics.

Orthodontically

An adverb, inferring manner of action.

Anomalies

Referring to those fundamental aberrations of growth and function which the orthodontist strives to establish in normal anatomic balance.

Dental Anomalies

Those where the teeth have deviated from the normal, in form, position, or relationship.

Oral Anomalies

Those which include other oral structures in addition to the teeth.

Eugnathic Anomalies

Those limited to the teeth and their immediate alveolar supports.

Dysgnathic Anomalies

Those which extend beyond the teeth and include the maxilla, the mandible, or both.

Dento-facial Anomalies
A term indicating a dysgnathic anomaly.

Macrognathia
Indicating a definite overgrowth of the jaw or jaws.

Micrognathia
Indicating marked undergrowth of the jaw or jaws.

Macroglossia
A definite overgrowth of the tongue.

Microglossia
An abnormally small tongue.

Myofunction
Referring to the function of the muscles.

Normal Relationships
Malrelationships
Terms applied to conjoining structures as they should be, or with this relationship disturbed or disrupted.

Normal Dental Function
Dental Malfunction
Terms to indicate the action of opposing teeth, sometimes referred to as "normal occlusion" and "malocclusion."

Anterior
Posterior
Terms to describe relative positions in a forward or backward direction.

Unilateral
Bilateral
Maxillary
Bimaxillary
Mandibular
Terms indicating the part or extent of the jaws affected.

Symmetrical
Asymmetrical
Terms indicating the manner of their involvement.

(a) *Contraction*
Distraction
Terms to indicate teeth or other maxillary structures too near the median plane, or too far in an outward direction from it.

(b) *Protraction*
Retraction
Terms to indicate teeth or other maxillary structures too far forward, or too far backward.

(c) *Attraction*
Abstraction
Terms to indicate teeth or other maxillary structures too high up, or too low down in the face.

(a) *Intraversion*
Extraversion
Terms to indicate teeth or other maxillary structures which are too near, or too far from the median plane.

(b) *Anteversion*
Retroversion
Terms to indicate teeth or other maxillary structures too far forward or too far backward.

(c) *Supraversion*
Infraversion
Terms to indicate teeth or other maxillary structures too high up, or too low down in the face.

In our discussion so far, an endeavor has been made to bring terms with definite meanings up for analysis, and show their advantages by comparing them with confusing and meaningless titles we encounter in our literature. From the beginning, *I have tried to emphasize the fact that this is a study and not an effort at finality.* The best progress can be made if we take a good list of terms, study and apply them, and if they prove logical, adopt them. Where they prove unsound, we must eliminate them from our orthodontic language. The best way to test a plan of terminology is to write a series of case reports. If you can make yourself thoroughly understood, then your terms are acceptable. To make progress in this task, we must free our minds from the handicaps of old habits, eliminate prejudices, and strive only to seek terms which tell the story of orthodontics in brief and understandable language.

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PRENATAL FACTORS IN FACIAL DEVELOPMENT (MANDIBULAR MALFORMATION)

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ORTHODONTISTS are primarily interested in certain developmental defects that appear in the mandible and which, by altering the proper occlusion of the teeth, cause dental disturbances which require correction.

My particular field of interest, which deals with the effect of the meteorologic environment on the human organism, might at first glance seem quite removed from yours. It will be the object of my discussion to explore the field that lies between these seemingly divergent paths to see whether they do not cross at certain points.

The particular dental situation in which you are interested is a malformation of the jaw. By comparison with other malformations of the head, it represents a relatively minor alteration, but because it is a growth disturbance, it must be classified and studied with the cephalic malformations in general. Considerable progress has been made in recent decades in this field, largely on the basis of studies in experimental genetics and experimental embryology. But while progress has been made, the problem has become more and more complex; therefore I will go into some of the details.

Malformations of the head, ranging all the way from complete absence to twinning or fusion of parts, to disproportion of parts, to cysts and tumors, are rather common in the human, possibly because developmental processes begin at the head end of the embryo, and it would be very easy for disturbances to occur at the time of the implantation of the ovum and its segmentation—when metabolic supplies are by no means established and when the metabolic balance of the maternal organism is not yet secured by the endocrine and metabolic stability that is so characteristic of the later stages of pregnancy.

When malformations of the head occur, other anomalies occur not infrequently in remote tissues—a phenomenon that is not due to chance, but which points to a very early disturbance underlying both the development of the head and central nervous system as well as the more remote regions.

Naturally the geneticist has sought to demonstrate the dependence of all malformations on disturbance of individual genes or gene constellations, but he has been balked by the fact that, though malformations in general may, in some instances be familial, there is no evidence that we are dealing with true Mendelian inheritance. Malformations of this type are bizarre and unpredictable. Sewall Wright[1] agrees that, while malformations may be genetic in origin, they may also be the result of environmental disturbances occurring during early development.

THE DEVELOPMENT OF THE EGG

I shall first discuss a few of the underlying phenomena that have to do with the development of the mammalian organism, in order to lay the background for

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the treatment of the developmental fault with which we are here dealing as a true malformation, that has its origin at the very beginning of the developmental processes.

In this field, involving as it does genetics, experimental embryology, physiology, endocrinology (particularly the growth hormones), and pathology, the advance has been very rapid. Fortunately a series of recent American monographs summarize the field. I would refer but to those of Paul Weiss,[2] Goldschmidt,[3] Spemann,[4] Morgan,[5] Just,[6] Pincus,[7] etc.

In the first place keep before you the picture of the ripe mammalian egg—a large cell with chromosomes (reduced to half the species number) making up the nuclear structure that is morphologically definable. The chromosomes contain the genes. These in turn transmit the capacity to guide the organization of the daughter cells. All this is embedded in a large mass of cytoplasm, with reserves of proteins, carbohydrates, fluids and minerals, complex vitamins and hormones. This ripe ovum, wholly maternal, has a limiting membrane, the ectoplasm, which makes contact with its environment—in this instance, with the follicular fluid of the ovary and later with the fluids and cells of the Fallopian tube and the uterine mucous membrane (Fig. 1).

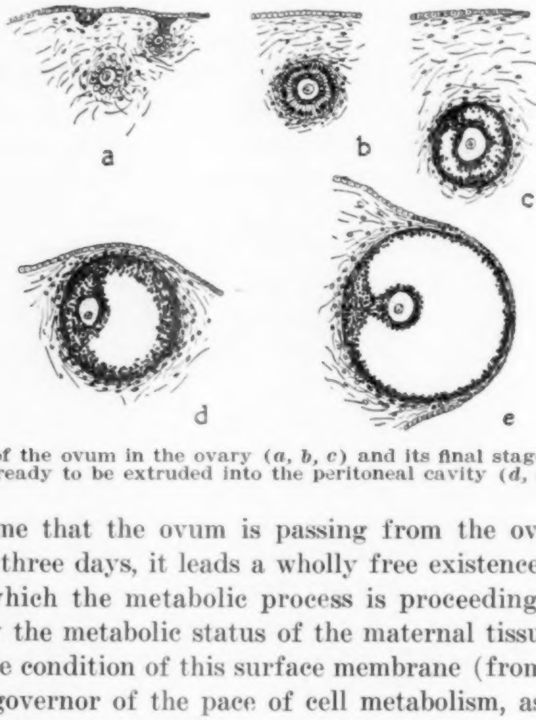

Fig. 1.—The ripening of the ovum in the ovary (*a, b, c*) and its final stage when it is free in the follicular fluid and ready to be extruded into the peritoneal cavity (*d, e*). (After Patten.)

During the time that the ovum is passing from the ovary to the uterus, a period of two or three days, it leads a wholly free existence. This cell has an inherent rate at which the metabolic process is proceeding and this must be (a) conditioned by the metabolic status of the maternal tissues and fluids, and, (b), modified by the condition of this surface membrane (from the biologic point of view, the vital governor of the pace of cell metabolism, as Just has pointed out).

The moment the cell has been fertilized, the external membrane (ectoplasm) changes its character completely; the metabolic processes are speeded up in an explosive fashion; cell division and organization begin, and later the young embryo burrows into the soft uterine membrane and becomes implanted (Fig. 2).

Before pointing out the significance for our problem, I would call your attention to differences in the rate of metabolism of such an egg: (1) depending on the inherent rate of the mother when the cell was still attached; (2) on the condition of the cell surface when the cell is free; and (3) on the age of the egg

at fertilization. The egg as it gets older changes its potential capacity for development, as Witschi[8] has shown. The colloidal state of the egg changes; it becomes less dispersed. Eggs fertilized early give the best results; if fertilization is delayed, malformations result more often, and the sex ratio is also changed; later even tumor formation is apt to occur in the embryos. Finally the eggs can no longer be fertilized.

During the developmental processes that now follow, we have to deal with the most complicated biologic processes imaginable. First of all, not only must we have available the proper dosage of biochemical guidance, which depends upon the genetic mechanism, and the proper supply and dosage (proportion) of the building blocks (stored or supplied nutrition from the maternal organism) but the relative growth of the parts must be kept within narrow limits. All must be properly timed. Not only must the spatial planes of growth in the three dimensions be considered, but the fourth dimension, time, is of primary consideration. In turn, the time factor is a matter of metabolic rate at which the biochemical processes are proceeding.

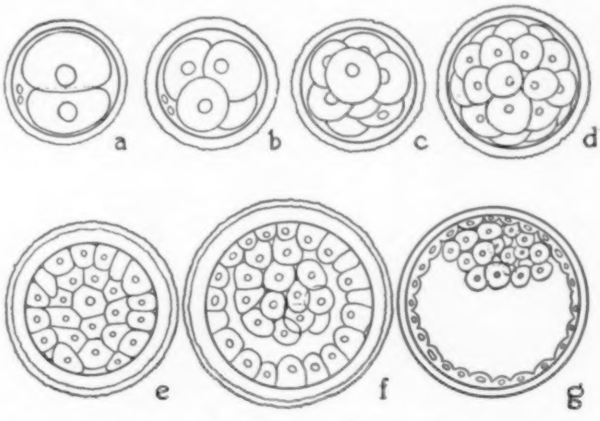

Fig. 2.—The early stages of segmentation, occurring after fertilization and during the time of passing down the Fallopian tube. In *f* and *g* the formation of the blastocyst and blastoderm has begun. (After Prentiss.)

For our particular problem we shall now have to consider the very early stages of embryonic differentiation. Cells in general exhibit polarity. They are oriented chemically, even if not anatomically. An egg exhibits polarity and possesses even a degree of preformation; i.e., the possible concentration of chemical substances or catalysts in spatial arrangement in the unfertilized cell. Weiss, discussing this point says, "All we ought to say is that specific relationships exist between certain localized areas of the egg (near the surface) and certain localized formations of the embryo."

Certainly in the mammalian egg, polarity is anatomically expressed in the development of the head as the governing center of the forces. From it, as an organizer (i.e., the metabolic rate or gradient in the sense of Child[9]), differentiation is controlled in a radiating fashion with a gradual extension to lesser fields of organization.

DISTORTION OF THE GROWTH IMPULSE

To Spemann, we owe the development of the concept that in the process of differentiation the first and governing field of force resides in the part that

centers around the chorda-medullary region, which I shall demonstrate. Fig. 3 reveals the surface of the egg with the gradual involution of the ectodermal medullary plate and the so-called neural groove, which form the brain and central nervous system.

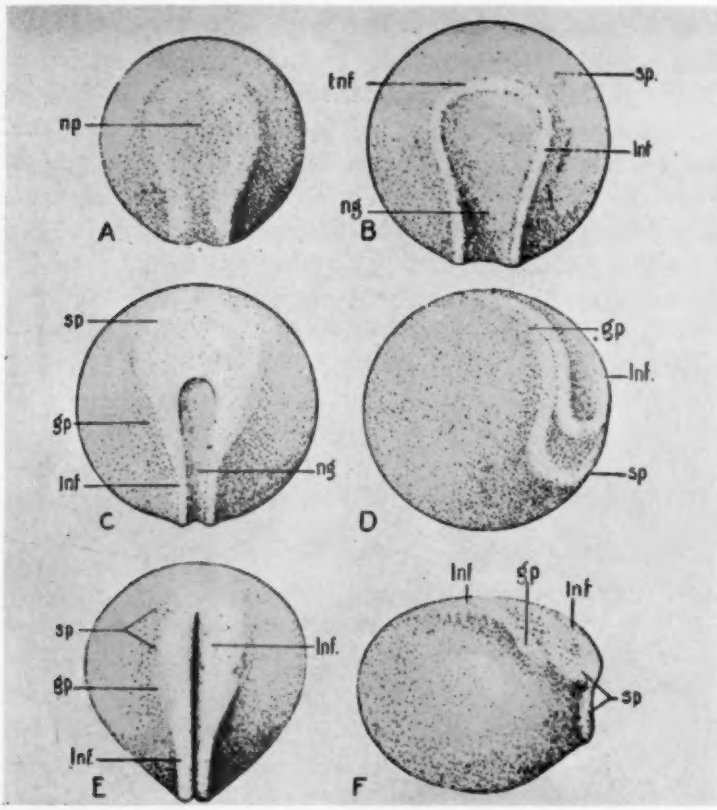

Fig. 3.—Transformation of the medullary plate into the neural tube in the frog. (From McEwen.) *A, B, C, E,* Successive stages of the closure of the tube. *D, F,* Lateral views of *C* and *E*. *np,* Medullary plate. *ng,* Neural groove. *lnf, tnf,* Medullary (neural) folds.

Fig. 4 illustrates the development of this critical area in cross section.

To quote Weiss: "The earliest field (i.e., the center of developmental activity which in turn governs the later fields of force) to be demonstrable in action is the *chorda-mesodermal field.* It gives rise by emancipation to fields of lower order ("sub-fields") within its own district. Concurrently it establishes the medullary field by inductive action. Gradually local sub-field districts emerge, such as those of the eyes, lenses, ears, nose, gills, balancers, mouth, etc., derived partly from the medullary field, partly from the chorda-mesodermal field, and partly possibly under the control of both. These local fields subsequently enter into competition for the available material and outline their mutual realms in accordance with their relative strengths. The final outcome is a mosaic of localized field districts (e.g., organ rudiments) with a high degree of autonomy and self-differentiating power. This result is achieved in two different ways: firstly, by the emancipation of sub-field districts, more restricted in scope, within original, more comprehensive, field districts; and secondly, by the conferring of field characters upon outlying materials, such as indifferent ectoderm (so-called induction). The local sub-fields are transitory stages in the transition of the germ from a state of indeterminacy of parts into a final stage where a maximum of definiteness has been acquired by each part. This transition is gradual and does not proceed at an equal pace in different parts."

Note what Weiss says about competition for available material: *"One growing part influences the other, and this competition may be influenced by the rate of growth, not only by the available building blocks."* Let me emphasize this by quoting further from him:

"In order to leave no doubt about the complexity of the growth problem, it seems appropriate to point out that, in addition to the differential effects attributable to the constitutional growth patterns, lack of uniformity in the response of growing systems to the *environmental conditions* accounts for further distortion of proportions in the course of development.

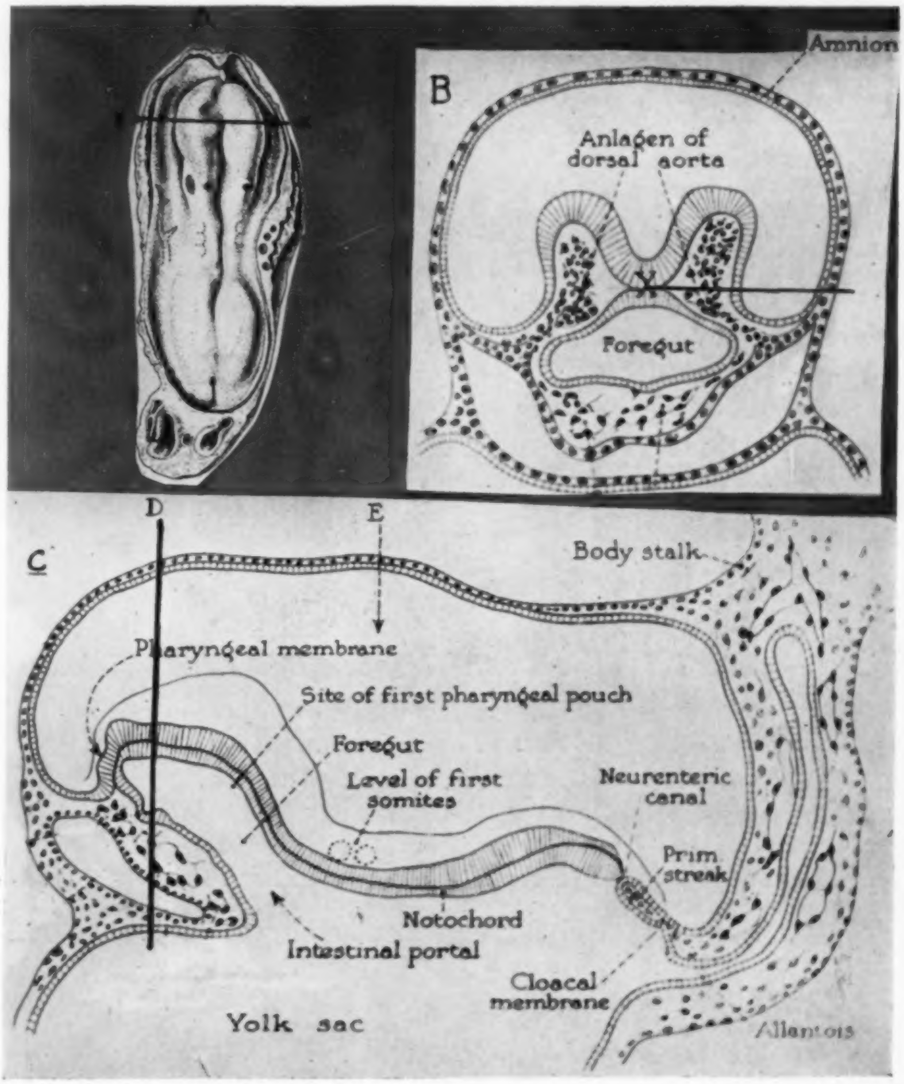

Fig. 4.—The critical chorda-medullary zone of organization. *A*, The early development of the neural groove (the amniotic sac removed). *x-x* is the line of cross section of the next figure. *B*, Cross section at *x-x* with the neural groove. At *X* is the region of contact of neural fold and notochord. Delay in proper separation in this region results in the Bagg-Little malformations, studied by Bonnevie. *C*, Longitudinal section of embryo—same stage of development. At *D* is line of cross section, *B*.

The effect of a change in the temperature level may be quoted as an example. As stated above, growth rates go up as the temperature level is raised. Since the basic temperature coefficient is nearly the same for all growth processes, one would expect that the growth of all parts would be speeded up proportionately so that the body would merely grow faster while

keeping its typical proportions. This is not invariably true, however. There are observations to indicate that a higher temperature level does not necessarily produce uniform acceleration of growth but often favors some parts to the disadvantage of others and thus distorts the proportions of the growth pattern.

"Quite generally, growth in higher temperatures leads to forms with longer appendages and a more jagged contour, whereas lower temperatures produce more compact forms with plumper and shorter appendages and with a simpler and smoother contour. Higher temperature promotes the growth of limbs, tails, gills, etc., more than that of the bulk of the body; the snouts, legs and tails of rats and mice raised in warmth are not only absolutely but also relatively longer in proportion to the body than those of specimens raised in the cold (Fig. 5).

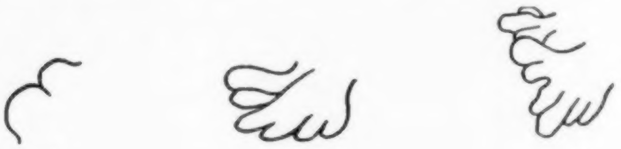

Fig. 5.—Effect of temperature on morphologic characters. Gills of frog tadpoles raised at three different temperature levels, drawn at comparable stages of development. *A*, 15° C. *B*, 23° C. *C*, 33° C. Note the increase in number and length of ramifications with increasing temperature. (From Doms, 1916.)

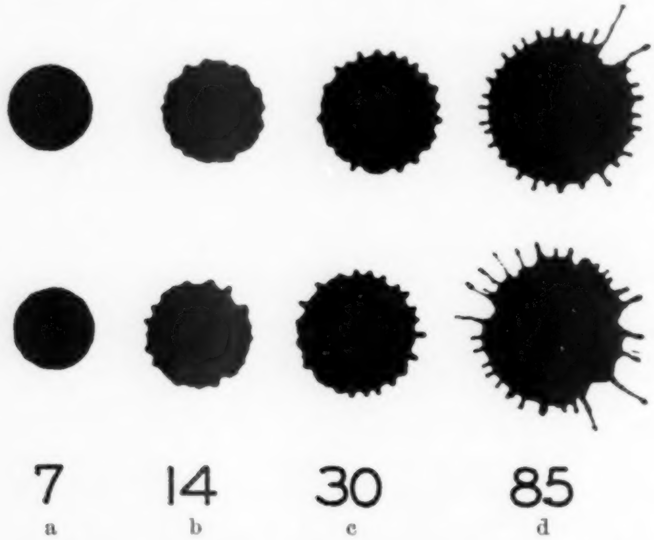

Fig. 6.—Morphology of ink spots produced by drops falling from different heights. Figures indicate height in centimeters. Increasing height of fall, that is, increased speed of spread or "growth," produces increase in diameter of spot, increase in number of protrusions, and increase in length of protrusions. (After Weiss.)

"There is a striking parallelism between the morphologic differences among individuals raised at different temperatures on one hand, and species growing in different climates on the other. Of two closely related species of which one lives in a cold and the other in a warm climate, the latter usually possesses appendages which are longer in proportion to the body than are those of the former."

Weiss illustrates the problems in a very different fashion in the following way (Fig. 6):

"When a drop of liquid falls on an even surface, the impact causes the particles to spread centrifugally at a rate which is in some proportion to the height of the fall. By increasing this height, one increases the speed with which the splotch forms after the impact, and consequently also the size to which it grows. The important point about this enlarge-

ment, however, is that it is not uniform, although quite regular. Let drops of ink fall upon paper from various heights. The drop falling from the lowest height, *a*, forms a round spot smooth in outline. A drop from the next higher level, *b*, is larger in diameter and its contour is wavy. Coming from still greater height, *c*, the drop displays distinct lobular processes along its circumference, and finally, if we increase the height of the fall still more, *d*, we observe that these processes become more numerous, slender, and longer. This series represents the morphologic results of the 'growth' of ink spots at different rates. It clearly illustrates that gradual change of speed does not only affect the *magnitude* of the result but also its essential *morphology*. The transition from the massive, smoothly outlined shape obtained at low speed to the starlike shape with its jagged contour at great speed imitates very closely the corresponding series of morphogenetic variations of organisms which have grown at different rates.

"Now for the explanation: The contour of the spreading ink spot is a compromise between antagonistic forces; the force of the impact tends to displace the mass centrifugally but forces of cohesion, surface tension, and elasticity resist and hold the mass together. Expansion is possible only to the extent to which, and as long as, the former overbalance the latter. The greater the speed, the farther the former extend before being checked by the latter. From a certain speed upward, the restrictive forces can no longer hold up the swift advance over the entire circumference. As a result, the expansive drive breaks through the front in certain weak spots which are due to random inequalities in the conditions of paper, ink, and impact. This opens gaps, as it were, in the line of resistance, and through these the ink flows out in a number of swiftly progressing columns. This has an important consequence; each local flow, once established, sucks in substance from the vicinity so that the central mass of ink keeps feeding into the various existing protrusions instead of establishing new ones. Thus the very act of producing a local outgrowth inhibits the production of a similar outgrowth within a certain range by directing all available substance and motion into the once established channel. The greater the velocity and the more vigorous the progress of the local outgrowth, the greater becomes the drain into it from the vicinity; the greater, therefore, are the inequalities of growth along the contour. This is the reason why the gain from a general speeding up goes primarily to those processes which have already an initial advantage."

It is obvious that we are dealing with something very similar in character when we deal with disproportionate growth of the various parts that are derived from the chorda-medullary plate region and which will make up the various parts and bones of the face.

With this as a background I would now like to have you consider malformations:

The *geneticist* can very properly point out that he can produce malformations that are hereditary by mutation of the genes. Usually such malformations are lethal. Mutations that occur in nature are chance—by that we merely admit that we do not know what causes them. They may result from active intervention such as x-rays, radium, undue heat or cold, and chemical effects.

The *experimental embryologist* can very properly point out that all varieties of malformations can be brought about by chemical or physical interference with the growth of parts during the various stages of development of individual organisms.

The *embryologist* can point out that many human malformations are associated with faulty implantation of the ovum (Mall).

The *physician* can point out that while human malformations are often familial in character, they are usually not inherited along true Mendelian lines,

and successive defects need not be similar. Malformations of the head in the human are frequently associated with other defects, particularly obvious in the extremities.

Finally, the peculiar growth disturbance that we find in the mandible is, according to Brodie,[10] not uncommonly found associated with minor malformations in other regions of the body. On the other hand, severe malformations of the head are often associated with mandibular growth disturbance.

We can then project that malformations in general, while possible on a true genetic basis, may more often be due to developmental disturbances effective very early in development and initiated by environmental alterations affecting the mother and, because of maternal reactions, effective in the biochemical environment of the young embryo.

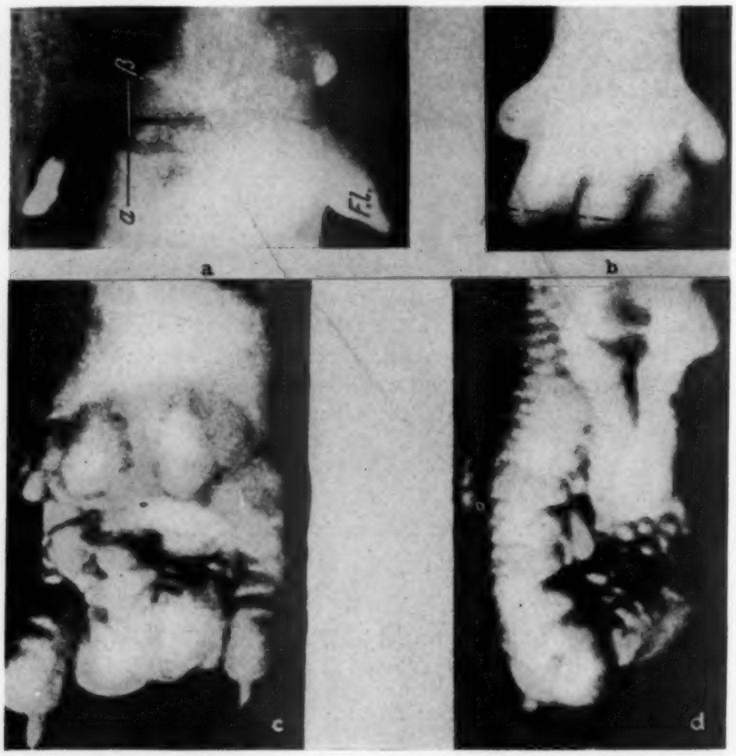

Fig. 7.—Characteristic mouse malformation with defects of the extremities. *a*, 10 mm. mouse embryo with shoulder blister (α—β). *b*, subcutaneous "blister" on hind foot of mouse embryo. *c* and *d*, foot malformation and stunting of toes. Bagg-Little mice. (After Bonnevie.)

In 1930 and in 1936 Bonnevie[11] published papers which have done much to clear the situation. In mouse embryos she was able to show that any delay in the separation of the mesodermal chorda and the ectodermal medullary plate (earliest anlage of the brain, central nervous system and the facial parts) could bring about growth disturbances that might result in acrania and encephaly, pseudocephaly, cranioschisis, as well as all the related disturbances of varying intensity. This delay in separation will, of course, take place in the earliest stages of human differentiation and depends primarily upon some

mechanism that slows the metabolic processes at the critical time of ectodermal-mesodermal separation (Fig. 7).

She found that this delay might be occasioned by a genetic mechanism such as that described by Bagg and Little[12] in 1924. It may, however, be due to an environmental effect.

Under such circumstances an increased amount of what may be termed cerebrospinal fluid is extruded through an opening in the roof of the fourth ventricle into the soft tissues of the overlying epidermis, follows paths of least resistance to the regions of the eyes, nose, face, neck and extremities and then, by distortion of the growth forces, brings about widespread anomalous development.

Fig. 8.—*a*, Girl, 8 years old, with pterygium colli and various malformations (mammillary displacement, nail dystrophy, lymphangiectatic edema). *b*, Girl, 1 year old, with neck folds, nail dystrophy, congenital lymphangiectatic edema. *c*, Girl, 2 months old, with broad neck folds, nail dystrophy, congenital lymphangiectatic edema. *d* and *e*, Newborn female infant with neck sac. *f*, Hands and feet of girl *b*. *g*, Baby girl, 2 months old, with lymphangiectatic edema of both legs and nail dystrophy. All cases reveal malplacement of the ear and ear deformities. (After Ullrich.)

From a paper of Ullrich,[13] I reproduce a series of illustrations of defects in children whose malformations are explained on the basis here outlined and from it I quote the following conclusion: "It is not to be supposed that all anomalies are to be explained on the Bonnevie, Bagg-Little mechanism. It is not to be doubted that quite similar phanotypic expressions (malformations) may originate in wholly diverse genetic or mechanico-developmental fashion, insofar as a

disturbance is effective at a certain time in development, in a similar place, and in a similar direction'' (Figs. 8 and 9).

Important is the recognition that a series of divergent malformations apparently originate in the earliest period of fetal development, due to pressure effects that follow in the wake of delayed separation of embryonic cell layers. Weiss puts it in this fashion: ''Not only may the same type of malformation arise in various ways, but various kinds of malformations may also be caused by the same disturbance.'' Or again, ''Every single character of an organism, with the exception of such primordial properties as nuclear size, biochemical species differential, and the like, is invariably the result of a chain of processes in which potentials are gradually led to realization in reaction to, and counteraction with, a varying set of circumstantials. Both potentials and circumstantials fluctuate independently; the interindividual variation is, therefore, of compound origin, and so are the excesses of variation which we call abnormal.''

Fig. 9.—Congential unilateral facial paralysis. Malformation of the ear and right upper extremity. (After Essen-Möller.)

Again, ''from the standpoint of embryonic dynamics, there is no such thing as abnormal size. There can be only abnormalities of size-controlling factors, and since, as has been shown before, there is a considerable variety of such factors in operation, a given abnormality of final size may be the result of any one of a number of causes. . . . In development it is the same story: component events whose timing or dosing is out of tune with the general plan, disturb, and often even break up, the whole performance.''

THE DELAY IN THE SEPARATION OF THE CHORDA-MEDULLARY PLATE REGION

We come back to the importance of the delay in the separation of the chorda-medullary plate and its role in disturbing the gross harmony of the facial parts. Regard now the altered mandible as one of the series of cranial anomalies. As long as we assume that the metabolic processes of the maternal organism proceed at an absolutely uniform pace, it might be difficult to see how an environmental effect might alter the metabolic processes of the embryo in its early stages.

Actually, we shall see, the metabolic status of the mother in our region of the world is changing from hour to hour, from day to day and from week to week and all such changes in the metabolic rate, in the oxidation-reduction potential, in the balance of the hydrogen-ion concentration, in the K/Ca ratio, or the iodine level or the blood pressure level, the body temperature—all must have some effect in the environment of the young embryo, and particularly in the young embryo which may have been poorly attached.

ENVIRONMENTAL DISTURBANCES IN BODY CHEMISTRY

I merely wish to illustrate that the body chemistry (and with that, of course, I include the body temperature and the metabolic rate) of the normal individual living in our region of the world is in a state of constant flux. Our bodies are literally tight-rope walkers on a flying trapeze, and our flying trapeze is the unstable atmosphere in which we live.

In the first graph I merely illustrate the daily blood pressure of a normal young woman whose only difficulty was the fact that she occasionally fainted. Observe that the systolic blood pressure changes from 100 to 130, and the diastolic blood pressure fell very frequently to low levels, after periods of high blood pressure. During that time the blood supply to the brain was inadequate, and she would faint. But her uterine blood vessels would also be affected (Fig. 10).

THE WEATHER

What makes the blood pressure go up? Any one of a number of environmental or emotional (endocrine) factors. The most common factor is the passage of a cold air mass. In the curve you will note that each increase in blood pressure was associated with such an environmental alteration.

But the metabolic rate of each individual is first decreased with such an episode as that here illustrated, when the body seeks to insulate itself against the environment. If such a decrease in the basal metabolic rate would occur at the precise time of the chorda-medullary separation, the environmental effect on the mother might influence the course of embryologic development.

Weather might become a factor in the production of malformations, and for a moment we will examine our weather (Fig. 11).

We have more of it, more varieties, more often, and more persistently throughout the year because we live in the mixing zone, where tropical and arctic air masses contest for mastery; usually they alternate. A bit of polar air breaks off from the shelf that covers the arctic region, pushes down as a tongue along the MacKenzie River basin or comes in over the northwestern highlands. It contacts tropical air masses that whirl up from the Gulf. The contact margins we speak of as "fronts," regions of great instability where there is often much precipitation, high winds, electrical disturbances, etc.

The track of the storm belt crosses America from west to east, and almost all of these air masses pass out over the New England region. Naturally we, who live in the pathway, must adjust more often and to a greater degree of change than those who live to the south or to the north of the main cyclonic track (Fig. 12).

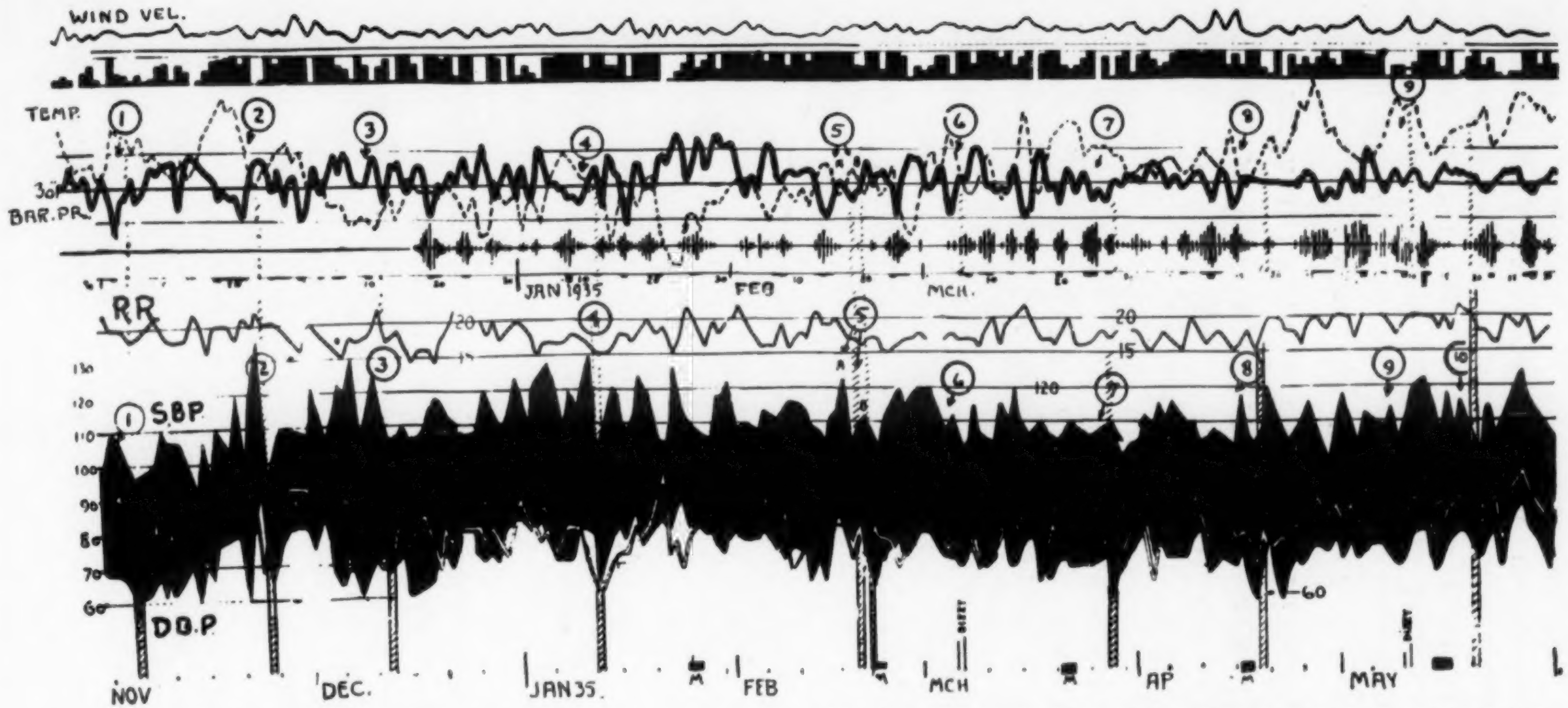

Fig. 10.—The day-by-day blood pressure curve of a young woman. Note the wide fluctuations with periods of increased blood pressure occurring in association with the passage of cold air masses. These are followed by compensatory declines. The upper graph indicates the meteorology, with the barometric pressure represented by the heavy line and the mean temperature by the dotted. Obviously the vascularization of the uterus would be equally unstable and such variety could be reflected in environmental change for the young embryo.
Period of Study, November, 1934, to June, 1935. *RR*— Respiratory Rate. *SBP*—Systolic Blood Pressure. *DBP*—Diastolic Blood Pressure.

MALFORMATIONS ARE REGIONALLY DISTRIBUTED

If malformations are in part due to such environmental turbulence affecting the metabolism of the mother, we may expect that malformations in general will be *regional* in distribution and they should reveal *regional annual trends,* because all the individuals of the human group living in adjacent states might be expected to be subjected to similar environmental effects, and these effects would, in turn, be reflected in damage to a corresponding number of embryos.

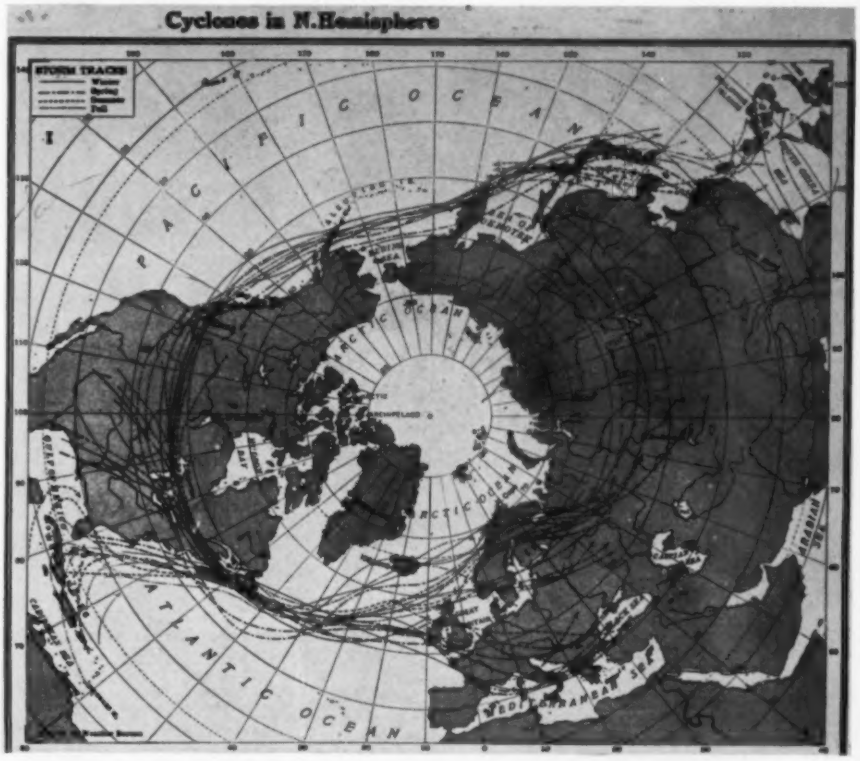

Fig. 11.—Storm tracks of the Northern Hemisphere. Note that the belt crosses the northern region of the United States.

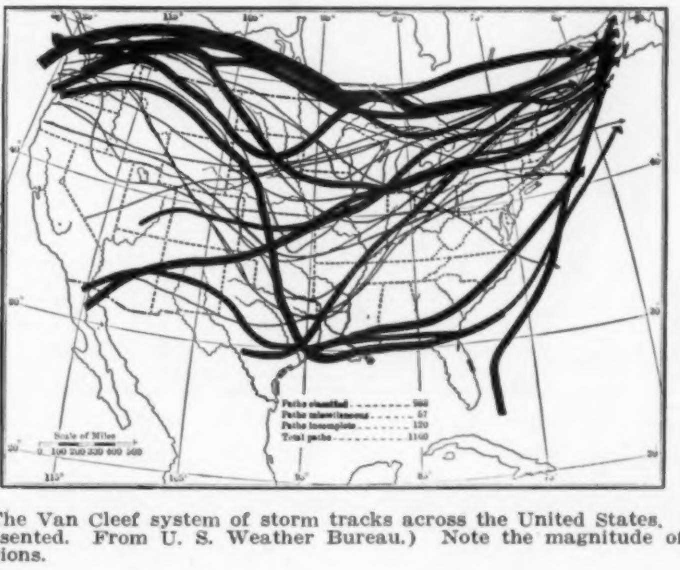

Fig. 12.—The Van Cleef system of storm tracks across the United States. (Twenty-seven tracks are represented. From U. S. Weather Bureau.) Note the magnitude of turbulence in the northern regions.

We examine first the map of the storm tracks as outlined by Van Cleef of the Weather Bureau; then a map on which cold, rainfall, cloudiness, barometric variability have been superimposed (Fig. 13). Note the very characteristic regional outline of that part of America which is subjected to unusual environmental strain. Then we examine the map which has been prepared of the malformations which were revealed in the draft (1917-1918) (Fig. 14). These malformations, of course, reflected embryologic damage that was not of sufficient degree to cause death. The individuals lived and reached the draft age. Then

Fig. 13.—Map of the major environmental factors governing organic reaction—cold, cloudiness, rainfall, and barometric variability.

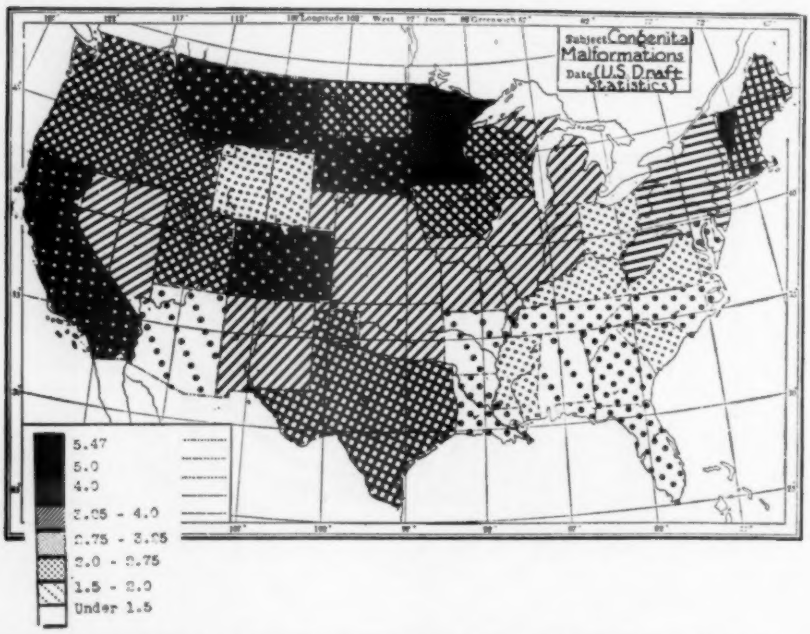

Fig. 14.—Proportionate number of malformations from draft records (1917-18). Note the northern preponderance.

we turn to deaths from malformations of infants under one year of age (in terms of the total number of births) (Fig. 15).

Note that in both instances the malformations are generally northern and that the northernmost states, Minnesota and Vermont, have the highest rate. The negro begins to have more malformations when he has moved north.

THE MALFORMATIONS REVEAL ANNUAL TRENDS

Now we examine the *annual trends.* Environmental factors are not alike from year to year. The seasons differ. These are climatic cycles; there is economic change, and there is crop change; there is food and water change and with that change in the mineral content; emotional forces that influence metabolism must be considered.

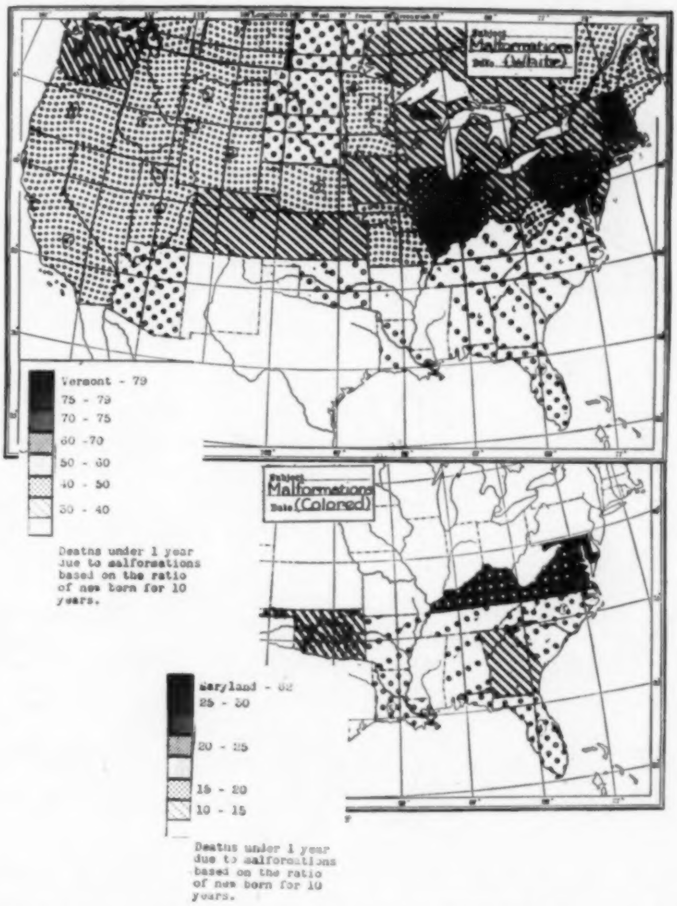

Fig. 15.—Deaths from malformations in the U. S. Registration Area in infants under 1 year, for the decade 1920-30. (South Dakota and Texas not included.) Note the characteristic increase in the region of the storm tracks.

When we take this malformation rate from year to year, based on the percentage of deaths in relation to the newborn, then we notice that in adjacent states the trend appears to be alike. In the New England region this is best brought out, possibly because our statistics are better, the population group is large, and the environmental effect is more nearly uniform in the geographic unit (Fig. 16). The correlation coefficients are positive and statistically significant.

TABLE I

CORRELATIONS OF NORTHEASTERN STATES

	MAINE	VERMONT	N. H.	NEW YORK	MASS.
Maine	1.0000	0.4000	0.5138	0.4473	0.4243
Vermont		1.0000	0.6206	0.4299	0.6811
New Hampshire			1.0000	0.6290	0.6456
New York				1.0000	0.7333
Massachusetts					1.0000

There can be no doubt of these figures; in the final analysis they can mean but one thing, namely, that for the human the genetic factor must be of relatively less significance than the environmental factor in the production of these

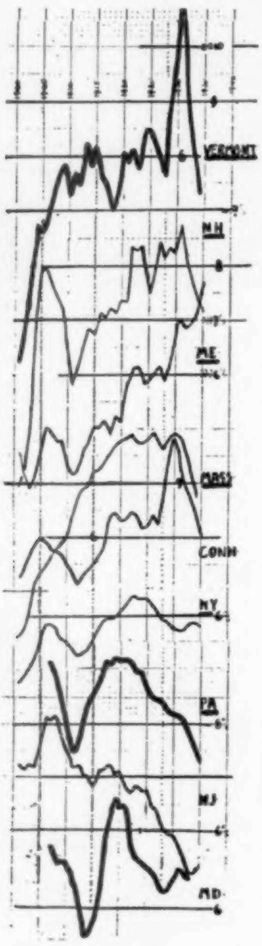

Fig. 16.—Annual trends for malformations in the eastern states 1900-35. Note similar trends for adjacent states.

malformations. If we were dealing primarily with genetic factors, there is no reason why these should not be relatively constant in the population at large from year to year.

THE SEX RATIO OF THE NEWBORN

Sex Ratio.—Now we must consider another factor which comes into the orbit of our interest.

Remember that it is delay at some critical time that apparently accounts for many of the malformations which we might properly term primordial disturbances in growth.

Normally the female has a slower rate of metabolism than the male. The male operates at a rate that is apparently 10 per cent greater; his standard of living is higher! There is a speeding up of all his biologic processes, mental as well as physical.

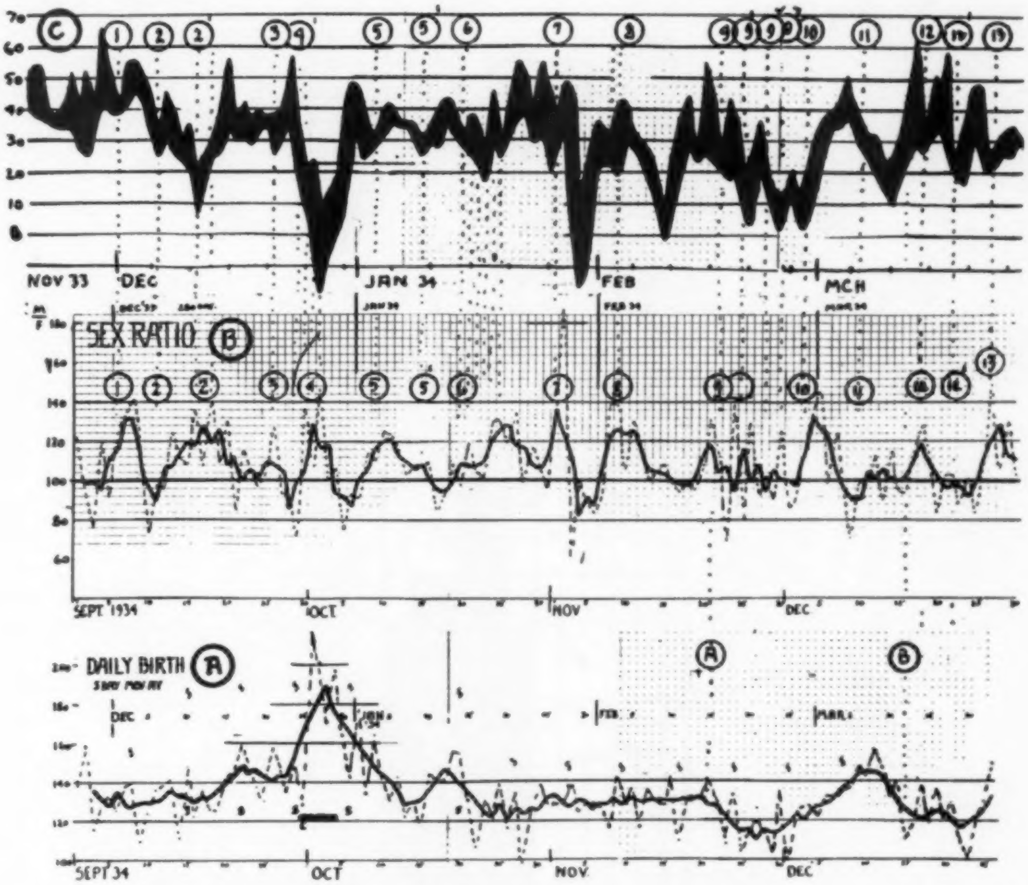

Fig. 17.—Day-by-day sex ratio of the newborn in Chicago. The total number is indicated by the lowest curve (*A*); the sex ratio is shown in the middle (*B*) curve; and the upper represents the maximum and minimum daily temperature 280 days before birth (*C*). Note the trend toward a greater number of males with the passing of cold air masses at the time of presumptive conception.

The metabolic rate goes up during the day and is higher in the afternoon and evening. Then, too, the metabolic rate increases with the passing of atmospheric fronts and after cold waves. The metabolic rate goes up with season, reaching a high usually in the late winter and spring and a low in the summer; periods of greater increase may be followed by periods of greater fatigue. If the metabolic rate is constantly varying, we can see the significance for our problem, for if slowing of the rate at some critical time is important for our problem, then we might anticipate that more of these primordial malformations that concern the head and the central nervous system, the backbone, the face and the special sense organs, might occur in female embryos because this basic re-

tardation is one of the reasons why the embryo becomes female rather than male, and why malformations of this type occur.

These forces which make for slower metabolism, operating at the very beginning of life should tend to produce disturbances of growth that would depend upon delay of separation of the ectodermal-mesodermal layers, such as those with which we are concerned.

In passing I merely want to call attention to the fact that change in weather, effective at the time of conception of the individual, pushes the sex ratio back and forth (Fig. 17).

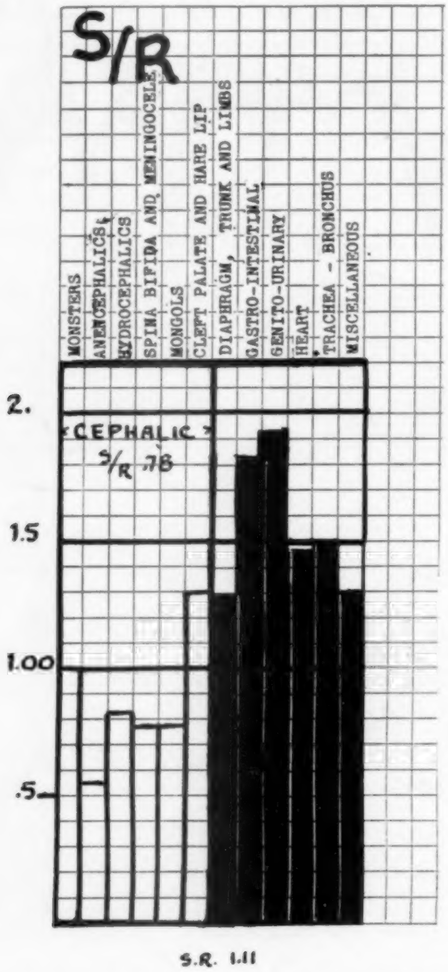

Fig. 18.—The sex ratio of 2512 infants dying from malformation in Chicago. Major cephalic malformations are indicated in white columns. Other malformations in black columns. Note female preponderance in the cephalic group with a sex ratio of .87. The sex ratio for the total group was 1.11.

The change in biologic status of the maternal organism toward lessened catabolism and relative alkalosis apparently produces more female babies; the change toward an increased metabolism and relative acidosis tends to create more males.

THE SEX RATIO OF CEPHALIC MALFORMATIONS

Turning back to the malformations, we now observe that in Chicago more of the severe malformations, that is, the cephalic type, are female (Fig. 18).

THE SEX RATIO OF THE MANDIBULAR MALFORMATION

Through the courtesy of Dr. Brodie the records of 193 patients of the clinic who have mandibular deformity of the first, second, and third degree have been placed at our disposal.

The sex ratio was as follows: There were 109 females, 84 males, giving us a sex ratio of .78, which evidently closely approximates that observed in the major cephalic malformations which resulted in death. And this strengthens the supposition that we are dealing with a disturbance that is established in the beginning of organic differentiation.

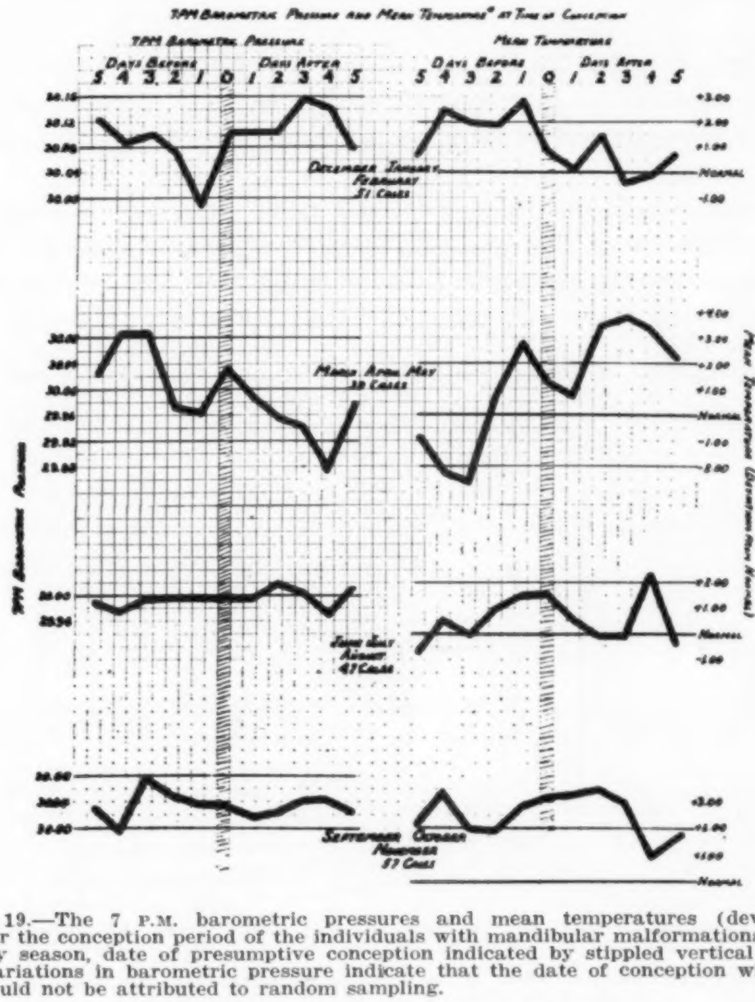

Fig. 19.—The 7 P.M. barometric pressures and mean temperatures (deviations from normal) for the conception period of the individuals with mandibular malformations (193 cases). Grouped by season, date of presumptive conception indicated by stippled vertical line. Spring and fall variations in barometric pressure indicate that the date of conception with respect to weather could not be attributed to random sampling.

THE WEATHER AT THE TIME OF CONCEPTION OF THE GROUP WITH MANDIBULAR MALFORMATION

We can now proceed a step further. If the mandibular malformation is in some way related to the metabolic disturbance of the maternal organism, and this in turn is associated with brusque weather change, then we might, by taking the birth dates of the individuals, and examining the weather 280 days previously (at the approximate time of conception) see if we can determine whether

or not meteorologic disturbance was actually in evidence. For the group provided by Dr. Brodie, Mr. Alvin Mayne made such a study and in Fig. 19, the mean barometric pressure for the five days before the presumptive conception and the five day period after the presumptive conception and the mean temperatures of the days are indicated for the period involved.

In the graph the material has been divided into four groups, those conceived in the winter months (December, January, February), those conceived in the spring, the summer, and in the autumn months (September, October, November).

The presumptive date of conception is indicated by the vertical stippled lines.

It will be noted that for the winter and spring months, meteorologic disturbance, as made evident by change in the barometric level, is evident with a period of low barometric pressure occurring before the presumptive conception date.

For the summer months the curve is flat, and I presume that other factors, here not considered, must be regarded as of greater moment during this period of relative environmental quiescence. In the autumn months, too, the alteration is not very great.

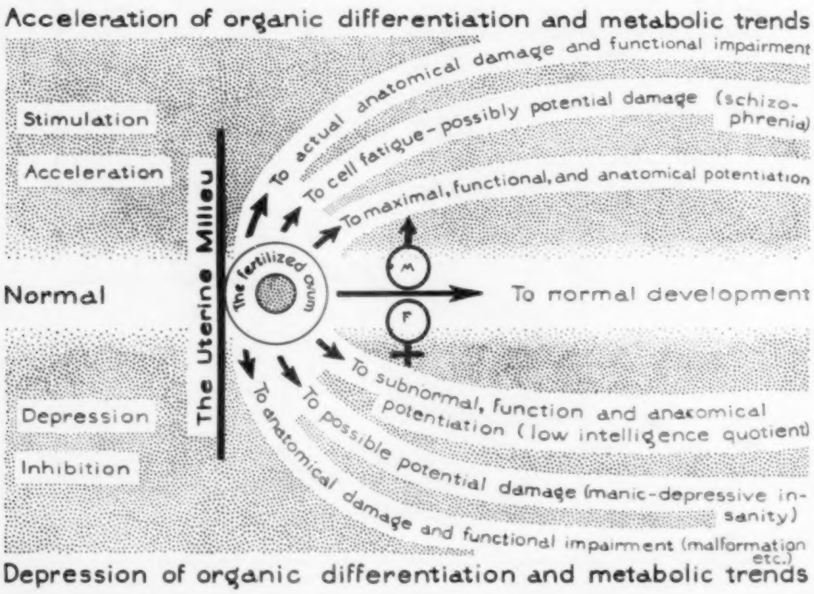

Fig. 20.—Diagrammatic representation of modification of genetically determined developmental trends by change in the metabolic gradient.

The temperatures, it must be observed, are at all times above the normal which would, of course, enhance the possibility of lowered metabolic rate and consequently increase the chance for delay in the separation of parts.

While a statistical analysis would make the results significant for only the winter and spring periods, it might at least seem probable that even this decidedly intangible approach here followed would lend confirmation to the theoretic assumptions that have been projected.

Fig. 20 will possibly illustrate the theoretic background of the potential developmental trends with which we are concerned in the embryo:

The metabolic status of the mother will swing between two poles—(1) an increased metabolic tempo with increased temperature, increased metabolism, etc.; on the other hand, decreased metabolism, decreased temperature and anabolic dominance. The sex difference will swing toward the male pole with the former and to the female pole with the latter. The cephalic malformations will occur more often when the trend is toward the female side but obviously malformations can occur most often with divergence to either extreme.

DISCUSSION

I have rapidly passed in review the fact that malformations[14] are regional, that the regional trends are alike from year to year, and that possibly it is environmental change (atmospheric or possibly of other origin) that may so condition the blood-vascular condition of the mother that the ovum before fertilization, or embryonic differentiation immediately after fertilization, is disturbed. If malformation can occur more frequently in the more northern states, then either the people differ, the soil differs, the water or food differs, or the climate differs. Since the rate varies from year to year and the trends are comparable in like regions, it must be a factor that varies from year to year and this factor will most likely be atmospheric.

As always in biologic problems, we must not be dogmatic, and we must grant that in the production of these anatomic faults, many other factors may play a role. Undoubtedly we deal with a constellation of events; possibly certain types of women will be concerned, we must remember that certain families produce more malformations than others, that the trend may be genetic and therefore involve either the ovum or the sperm.

But I should like to stress that the effect can hardly be wholly genetic because we cannot well conceive of a genetic factor that would operate regionally in annual trends that are identical.

Some twenty years ago Levy[15] demonstrated that by ice treatment of frog eggs during the very earliest stages of the formation of the primitive streak, a spina bifida could be produced in tadpoles.

"In a consistent progression, developmental malformations (in tadpoles) could be traced to injuries to the individual when the haploid egg cell was compelled to divide. An injury, in this instance the suppression (delay) of cytoplastic division in the presence of nuclear division in a single cell, (here the ovum) leads to the development of heteroploid tissues and heteroploid organs."

The spina bifida so produced cannot be regarded as hereditary in any sense of the word, and even if the change had been produced in the individual egg cell before fertilization it would not be regarded as hereditary.

The work of more recent investigators (Kristine Bonnevie, Bagg and Little (1924), Ullrich, Landauer,[16] etc.) sheds much light on the genetic processes, with the probability that in some instances the fault involves a constellation of a whole series of genes. But even here it has become evident that there is no direct and fixed relationship between the genetic fault and the final expression which this fault may take as a malformation.

Bonnevie showed definitely that a whole series of malformations in mice (anencephaly, pseudencephaly, cranioschisis) can all be due to a genetically conditioned, delayed detachment of the endodermal chordal plate from the base of the ectodermal neural tube; the disturbance in the developmental balance thereby engendered was followed by all varieties of malformations on a purely mechanical basis.

Ullrich in a more recent review comes to the conclusion that I shall quote:

"With the demonstration that a series of diverse anomalies might be due to a single genetic cause, it must not be concluded that all these anomalies are genetically identical and to be identified with the recessive Bagg-Little type—it is not even necessary to assume the identity of a particular gene or gene grouping for these anomalies. There is nothing against the assumption that an increase in the fluid extruded from the neural canal may be occasioned by an idiotypic or even intrauterine-peristatic, i.e., environmental, factor. The genetic factors can be wholly separated from the developmental mechanism and the present status of malformations in human development regarded as an open question."

If this is an open question, then it is logical to seek the solution in an examination of the environmental factors that may have been effective at the earliest stages of embryonic differentiation. Among these environmental factors none are more potent from the biologic point of view than the change in the air mass in which the organism exists. On this basis even minor disturbances of growth of the facial parts should be considered from the point of view of the possibility that retardation of the metabolic processes occurring at the time of separation of the chorda-medullary structure is of significance in the production of the deformity.

We can then conclude that anomalous growth of the mandible is to be regarded as a cephalic malformation and takes origin in metabolic disturbances acting at some critical time in the medullary-notochordal field of organization. As with the cephalic malformations in general, they occur predominantly in the female, and our investigations would make it probable that the major factor that causes the disturbance involves the environmental situation of the maternal organism (weather) at about the time of conception. While the defect is prenatal and ordinarily would be regarded as hereditary, the actual mechanism is not strictly genetic but is due to peristatic effects on the cytoplasm of the ovum or the rapidly developing embryo. A simulated sex linkage is to be explained on the same basis.

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THE CONSTRUCTION AND MANIPULATION OF THE TWIN-WIRE MECHANISM

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During the past twelve years I have written so many papers and given so many clinics on the twin-wire mechanism that it is almost impossible for me to say anything about the subject without repeating myself. However, for the benefit of those who are not acquainted with this appliance, I shall give a brief description (Fig. 1*A*).

The twin-wire arch is composed of two tubes into which a doubled, fine stainless steel wire is drawn. I call these the end tubes, to differentiate them from the tubes attached to molar bands. The end tube is made of stainless steel. The outside diameter of this tube is 0.036 of an inch and its inner diameter is 0.022; it is 1⅛ inches long. A precious metal hook is soldered to this tube when intermaxillary rubbers are to be used.

The hard stainless steel wire, 0.010 or 0.011 inch in diameter, is doubled on itself and passed through the end tubes, as illustrated in the first arch. The loose ends are crimped with a round-nosed pliers. The arch is then placed in a vise designed for that purpose (Fig. 1*B*). The beaks of the vise are opened and the steel wire is drawn into the tubes, equal distance from each end. I usually draw the midsection until it is 1½ inches long.

Fig. 1*C* shows a soldering jig I use to solder the hook to the tube. It insures that the joint is well soldered and that the hook is correctly placed on the end tube. I am careful to flow solder completely around the tube. This will eliminate any danger of the hook breaking off. The hook is soldered 1/16 of an inch from the end of the tube, thus avoiding the danger of stopping it up with flux. When the hook is polished the tube is cut off flush with the hook, as shown in Fig. 1*A*.

Fig. 1*D* shows the different variations of the twin-arch; it also shows the shape of the arch when it is removed from the vise. The twin-wires or midsections are made in two sizes, 0.010 and 0.011 of an inch in diameter. The cases are usually started with the 0.010 and finished with the 0.011. In distoclusion, where the teeth are fairly regular, I frequently start with the 0.011, for naturally the wire of larger diameter does not break as easily as the smaller. Please note the little coil-springs on the midsections. I shall later refer to their use, also to the extremely short tubes. Frequently when the arch is pulled one of the hooks will be rotated. This seems to be due to a rifling in the tube and can be corrected by holding the tube with a Young plier, and, with a Howe plier, twisting the tube at the hook. I keep some of these defective arches in stock and use them to move canines into alignment. If the twin-arch is placed in the

Read before the New York Society of Orthodontists, New York City, March 11, 1940. Given as a lecture clinic before the American Association of Orthodontists, Chicago, Illinois, May 13, 1940, and read before the Washington-Baltimore Society of Orthodontists, Baltimore, Dec. 5, 1940, and before the Pacific Coast Society of Orthodontists, San Francisco, Feb. 20, 1941.

buccal tubes, so that the hooks are upside down, the rotated hook exerts an ideal force that moves the canine lingually.

As previously mentioned, when the arches are made, the midsection is pulled one and one-half inches in length and later drawn out to suit the individual case. I keep a large number of the arches in stock and am very extravagant in their use, for they are easily constructed and are inexpensive. A trained assistant can make twenty-five in a morning.

Before going farther I shall explain why I use two small wires instead of one large wire:

1. A small wire is much more resilient or springy than a large one. The small steel wire that I use in the arch will spring back to its original form when bent out of shape, but a single wire of this small diameter does not exert

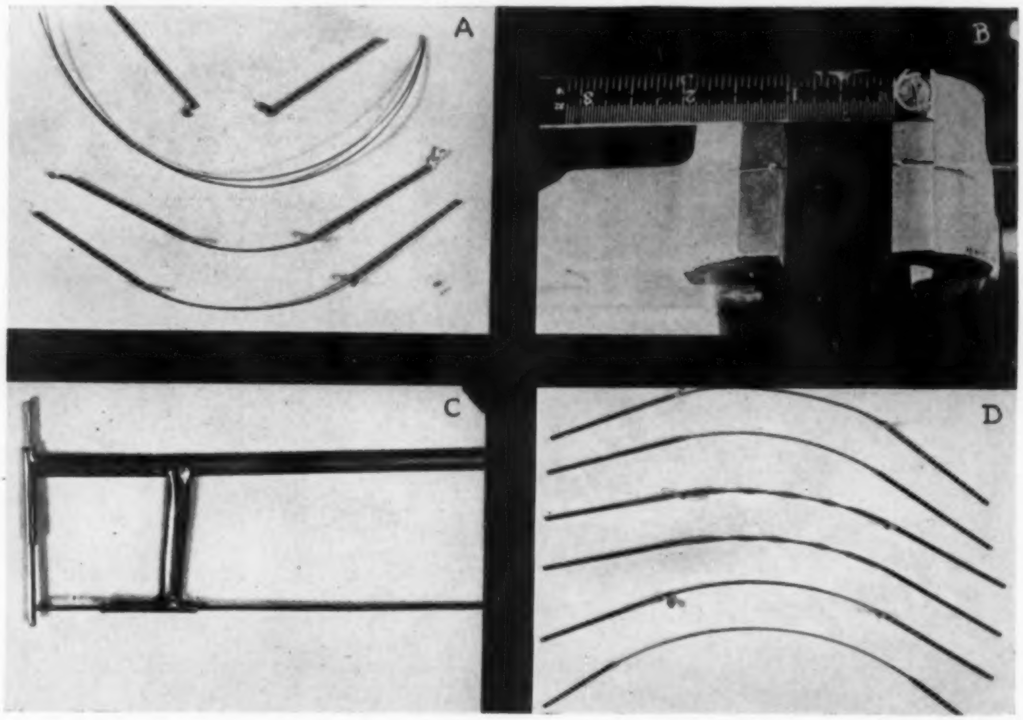


Fig. 1.

enough force to move a tooth. By doubling the small wire I obtain an alignment arch which has enough resiliency to spring back to its original shape when distorted and which is strong enough to move a tooth. I have found, through a series of experiments over a number of years, that the 0.010- and 0.011-inch wires are the best sizes to use. They will bear an eight-ounce force of distortion before a crimp is formed in them. This makes the appliance almost fool-proof; for, if it takes more than eight ounces of pressure to seat the arch in the lock, it crimps and thus prevents one from exerting too much pressure on the tooth (Fig. 2).

2. With two wires I obtain bodily movement of the teeth; also there is a torque in the arch which tends to tip the crowns into normal position. There are, however, a few cases in which I desire more forward tipping of the apices than the arch is capable of exerting. In such instances I draw a 0.025-inch

steel wire into the end tube in the same manner as I do the twin-wires. I flatten this wire by passing it through a gold-rolling machine. With practice one can roll any desired pitch or torque into this wire. I very seldom use this arch.

The twin-wire arch does not work properly if ligated to the teeth with wire or grass ligatures. This is especially true in the maxillary arch. In the mandibular arch, when only minor tooth movement is necessary, it works very well with ligatures. The ligature should be placed in such a way that the ends can be bent into the interproximal spaces, so as not to scratch the lip.

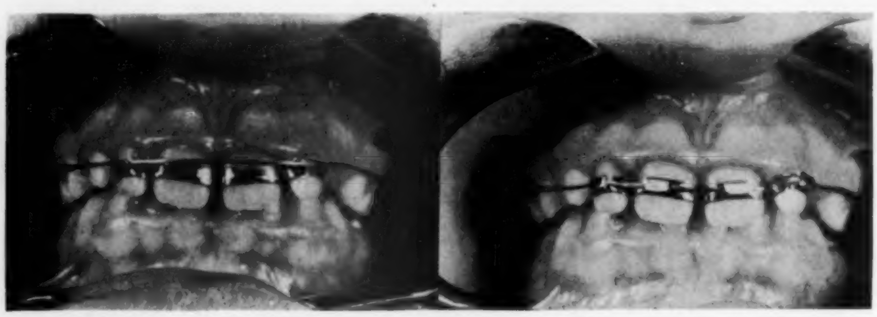


Fig. 2.

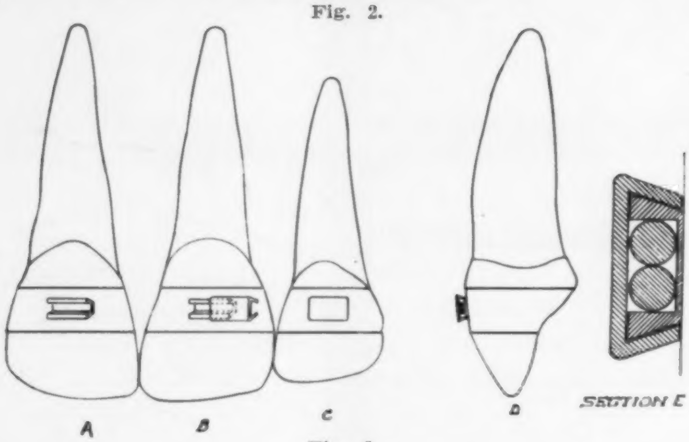


Fig. 3.

For the benefit of those who have not seen the locking device used to hold the arch in position I shall give a brief description of it. This device is composed of a male and female part. The male is welded in the middle of, and parallel to, the edges of the band (Fig. 3). It has parallel walls forming a channel in which the twin-wires are to be seated. The outside wall is dove-tailed. The female part, which for the sake of clearness I call a cap, slips over it and is held in place by friction. The locks are $\frac{1}{8}$ inch long, $\frac{1}{16}$ inch wide and $\frac{1}{32}$ inch thick. They are streamline in shape and do not catch food or scratch the lip. With a sandpaper disk I give them a sharp bevel before placing them in the mouth. They can be trimmed shorter also. However, I prefer them $\frac{1}{8}$ inch long. They are supplied welded to seamless bands.

The bands are made in four sizes, but I seldom use any other than the two largest. The bands are 0.005 inch thick, and $\frac{3}{32}$ or $\frac{1}{8}$ of an inch in width. I have been using the narrow band for the last eight years, and often have wondered why the majority of orthodontists still cling to the $\frac{1}{8}$-inch width bands.

The $\frac{3}{32}$-inch band has the following advantages over the wider bands:

1. Its appearance is more esthetic. It is surprising how much better the narrow bands look in the mouth.

2. It conforms more readily to the contour of the teeth, which helps toward a better and easier fit.

3. It does not interfere as much with the contact point.

4. It does not come loose any oftener than the $\frac{1}{8}$-inch band; in fact, a loose band is not one of my problems.

5. When I wish to remove this band, it comes off without tearing.

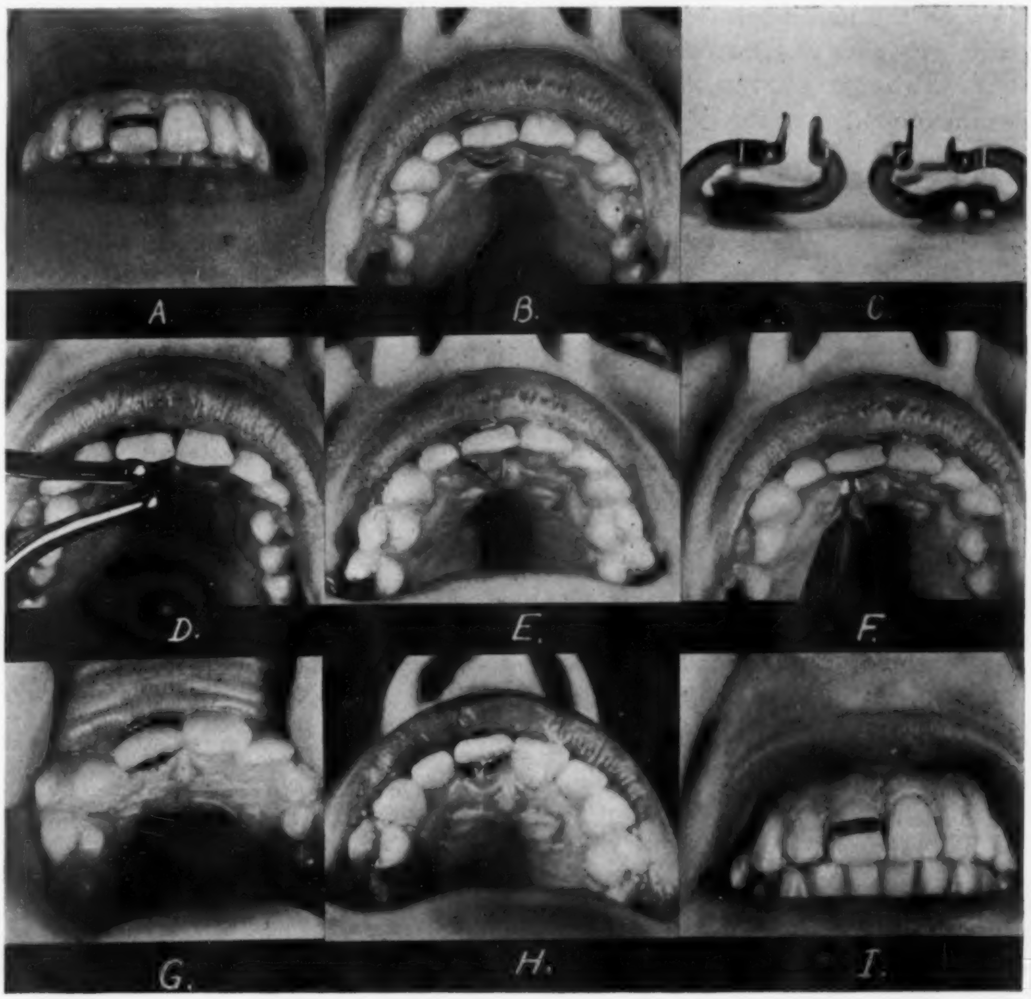


Fig. 4.

Some think the 0.005-inch band is too thick and takes up too much space at the contact point. If I find this condition has arisen, it is a simple matter to correct it. After the band is made and fitted to the tooth, and just before it is cemented, I take a sandpaper disk and polish it at the contact point. This gives the desired thinness and does not weaken the band, for bands break on the lingual or labial surface, and practically never at the contact point.

I use a seamless band, because in employing the following technique I find it much easier to fit it to the tooth. The band is slipped over the tooth to the desired position (Fig. 4*A* and *B*). Then, with a rubber-dam clamp forceps, a forceps that has been modified by shortening one beak and flowing soft solder on it (so that when it rests against the lingual surface of the tooth it will not slip) and by the grinding down of the other beak until there is a slight hook at the end to prevent it slipping off the band, Fig. 4*C*, the two beaks are slipped between the lingual surface of the tooth and the band (Fig. 4*D*). The handles are compressed; this opens the beaks and stretches the band tightly around the tooth, and at the same time forms a loop on the lingual surface similar to the loop on my molar band (Fig. 4*E*). With a Howe pliers this loop is pinched together (Fig. 4*F*). After the pinch has been made, I use the same pliers to burnish the band to the lingual surface of the tooth, for a band should fit as well on the lingual as on the labial (Fig. 4*G* and *H*).

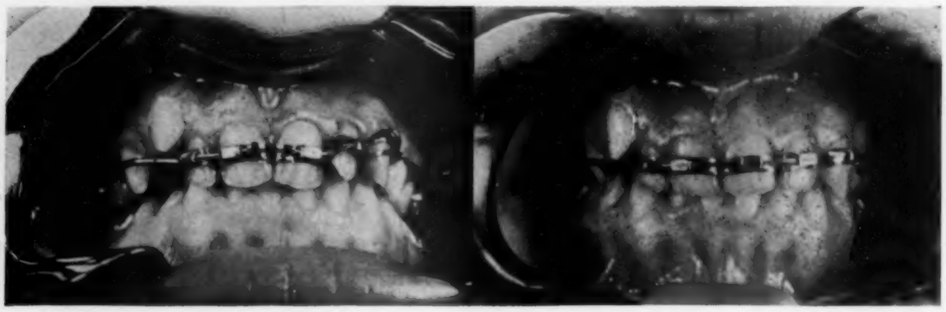


Fig. 5.

If there is space between the teeth all the bands are fitted and pinched before they are removed and soldered. If the contacts are tight a band is fitted and its position on the tooth is marked with a hard lead drawing pencil. It is then removed and the next band is made and marked, and so on around until all are finished. Bands can be made very quickly by this method. Usually only ten minutes are required for two molar and four anterior bands.

In fitting anterior bands I am very careful not to place the band so high it will impinge on the interproximal tissue. The lock is usually placed in the center of the tooth (Fig. 4*I*). If the bands are correctly fitted the locks are at right angles to the long axis of the tooth and should be placed on it so that when the teeth are moved to their correct position the locks will all lie in the same plane (Fig. 5). One can usually judge this with his eye, but when in doubt, I measure from the incisal edge of the tooth to the edge of the lock with a caliper. This placing of bands at the correct position on the teeth is very important, for the twin-arch automatically lengthens or depresses a tooth if the bands are not placed at a uniform distance from the incisal edge.

I usually make the molar and the anterior bands at the same sitting. I take a modeling compound impression with the molar bands in place. For beginners with the twin-wire appliance, it might be a good idea while taking the impression to leave the anterior bands on also, as it will help them to line up their molar tubes if they have the anterior bands on the model. I, however, remove the

anterior bands before taking the impression. After removal of the bands, the patient is dismissed and the bands taken to the laboratory. They are soldered with 18-carat solder and the pinches cut off and polished flush with the band and the appliance constructed as previously described. At the next appointment I cement on the whole upper appliance. This usually takes an hour and a half. So, I keep the patient out of school, for I must not be rushed, and, besides, I like to have ample time to burnish the bands and be sure they are properly fitted, for the entire success of the case depends upon the appliance and the bands being correctly fitted.

I find a modified orthodontic wrench the best instrument to drive a band to place. With a stone I cut away the wrench part and bevel it. The bend in the shank and the bevel tend to drive the edge of the band against the tooth rather than to lift it away, as do some of the band drivers now in use. If the band is a very tight fit you may crimp it while driving it on. Although this affects the appearance of the band, it does not weaken it, and for practical purposes this band is as good as the others. However, for esthetic effect I try to avoid crimping it.

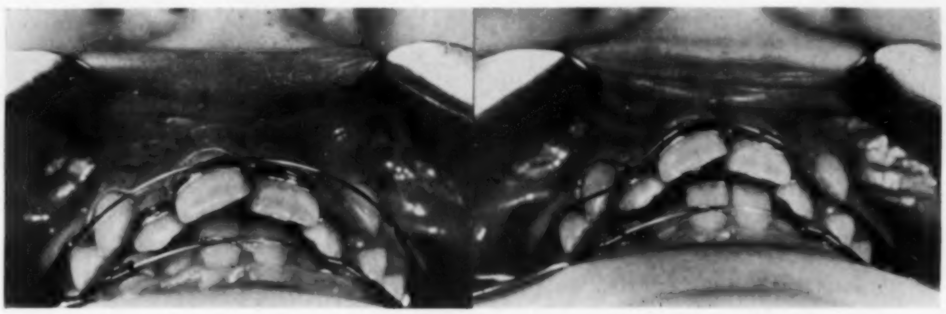


Fig. 6.

The twin-wire arch is also placed at this time. Fig. 6 illustrates one of the many advantages of the twin-wire arch, that is, when the arch is placed in the buccal tubes, it automatically assumes the shape of a normal dental arch without bending or manipulating. If the teeth are very irregular the twin-wire arch is seated in the lock and crimped with the seating pliers. A flat amalgam instrument with a notch cut into it also is good for this purpose. This crimping is done to avoid making the teeth sore. I use a wire ligature in those cases where the teeth are so irregular that it is not advisable, or even possible, to seat the twin-wires in the locks at the beginning of treatment. For example, see the left lateral incisor in Fig. 7.

Two pliers, *D* and *E,* Fig. 8, are used to seat the cap. The *E*-plier, called placing plier, is used to pick up the cap or female part and start it over the male attachment, Fig. 9*A*. The *E*-plier is furnished with a stop which permits a slight tightening of the cap. If trouble is experienced with the caps coming off, grind down the stop until the caps fit more snugly; then they will not come off. The *D*-plier, called seating plier, is used to complete the seating of the lock. It has two grooves in the beaks, one for maxillary and the other for mandibular teeth. The grooves fit over the twin-wires and force them into the seat of the male part, and at the same time the beaks are closed, which completes the seat-

ing of the cap, as in Fig. 9*B* and *C*. To remove the lock, one beak of the seating plier is placed against the side of the tooth while the other beak rests against the corner of the lock; then by closing the beaks of the plier the cap is forced off as is shown in Fig. 9*D*.

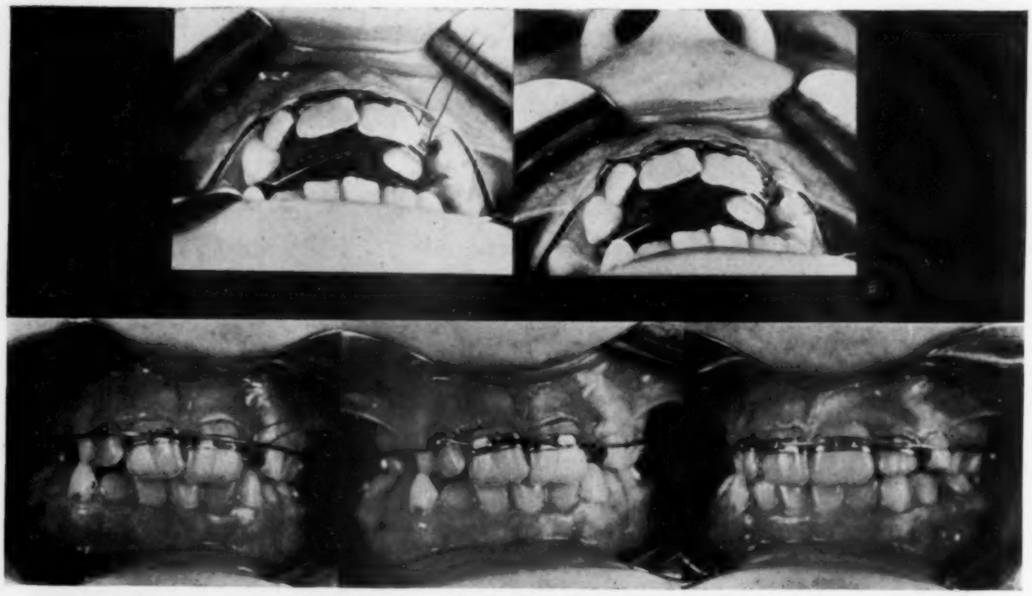


Fig. 7.

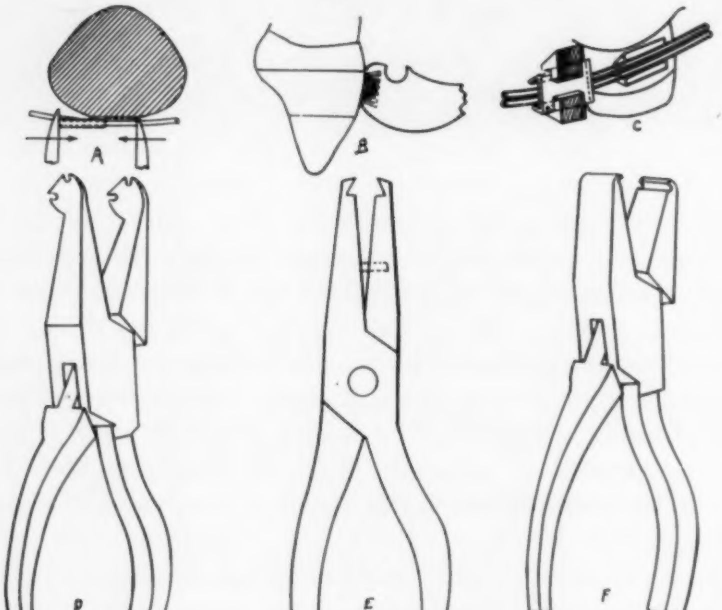


Fig. 8.

When I first began with the twin-wire arch, I used a lingual appliance to stabilize the molar anchorage. Later I discovered that the outward force of the ends of the arch was so slight that there was no need to shape it. It can be placed in the molar tube, in the form it is drawn in the vise, for it has no effect on the molar anchorage. When it is slipped into the molar tubes it automat-

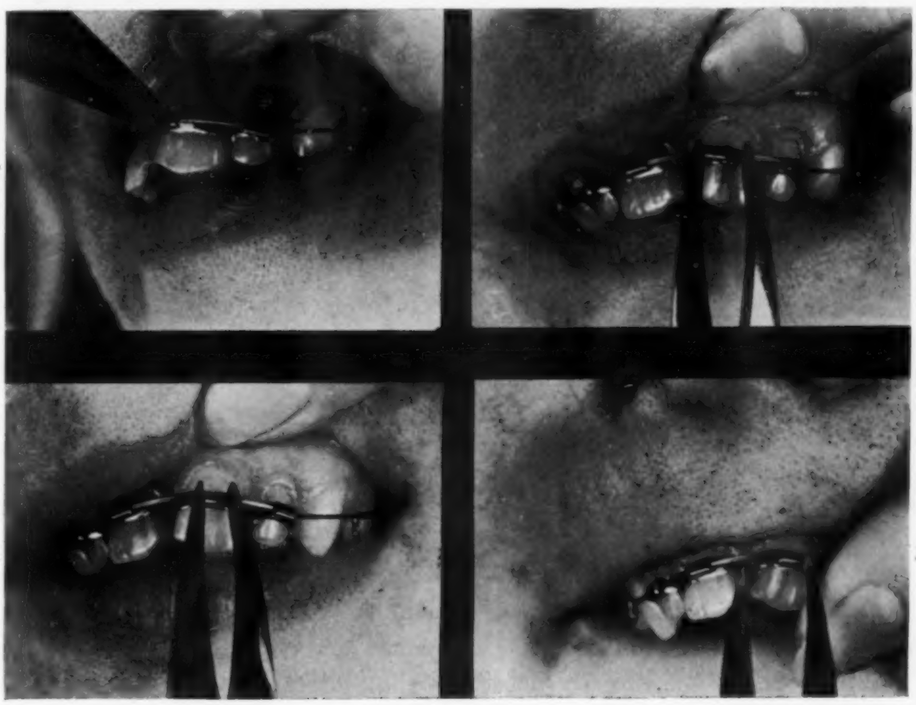
ically assumes the shape of a normal dental arch. There is no need to shape it in any way, except to lay it on a flat surface and to see that it lies in a horizontal plane.

Only two auxiliary accessories are necessary with the arch. One is the wire ligature shown in Fig. 7, and the other is the coil-spring, the latter being a very important adjunct to the appliance.

I shall describe in detail the making of coil-springs and the pressure exerted by their different lengths, sizes, and diameters.

In Fig. 10, at the top, is the mandril on which the coil-spring is wrapped. I do the wrapping with my dental engine. The mandril is made from a rubber cleaning-cup mandril. When the rubber cup is unscrewed the threaded hole is slightly smaller than a 0.036-inch molar tube, so I solder the described size wire or core in the buccal tube, and this tube is then driven into the mandril where the cup has been removed. Next, the mandril is cut off about ⅓ its length and a notch is cut horizontal on the end to engage the wire which is to be wrapped into a spring. The wire or the core, soldered in the buccal tube, is made one gauge smaller than the bar over which it is to fit. So, if I want a spring to fit over a 0.036-inch end tube, I wrap the coil-spring over a 0.032-inch core. This gives me a coil-spring that fits the 0.036-inch end tube snugly, but not so tight as to bind and destroy its efficiency.

A. B.



C. D.

Fig. 9.

After the coil is wrapped it is removed from the mandril and pulled out twice its length. It is next replaced on the mandril and compressed as much as possible, and then taken off and cut to the desired length. When the spring was stretched the portion held between the finger tips was not stretched. When I cut the spring I take advantage of that fact and cut it so that I will have at

least three wraps of this tight portion on the end of the coil. These tight wraps are of a slightly smaller size than the stretched portion so that they fit the end tubes tighter. Then when I pinch my stops in the end tubes, it requires only a very small dent to make it hold. After the spring has been stretched and recompressed, there is still enough resiliency in it so that it can be compressed one-half its length. For instance, if I cut the spring ½ inch long, it can be compressed to ¼ inch, and a ¼-inch spring can be compressed to ⅛ inch. When the pressure is removed it will spring back to ½- and ¼-inch lengths, respectively.

I use a 0.009-inch hard stainless 8-18 steel wire for my end tube coil-spring. I have found a ½-inch coil-spring is the best length. A spring of this length when compressed to $\frac{1}{32}$ of an inch will exert a force of one and one-half ounces. At the end of two weeks another $\frac{1}{32}$ of an inch is compressed. Thus the spring is compressed $\frac{1}{16}$ of an inch which exerts a pressure of three ounces on the molar tube. This is enough force to start the molar to move distally, and at each appointment the coil can be compressed another $\frac{1}{32}$ of an inch until the molars have been moved back the desired distance (Fig. 11).

It is not necessary to remove the twin-arch to compress the coil-spring. I use a sharp-nosed pliers, preferable the Young pliers (designed by the late J. Lowe Young) to flatten the end tube in front of the coil. This flattening of the end tubes makes a good stop and eliminates the necessity of removing the arch.

Fig. 10.

The coil-springs which are threaded over the twin-arch section to move the anterior teeth, mesially or distally, are made of 0.0056-inch hard stainless steel wire alloy 8-18. It is wrapped on a 0.020-inch core in a dental engine, employing the same technique as was used in making the coils for the end tubes. Before the twin-arch is assembled, I thread two ¼-inch and three $\frac{1}{16}$-inch lengths of coil-spring over the twin-wires. The end tubes are then slipped over the twin-wires and the arch pulled, as already described. In some instances a ⅜-inch length coil is substituted for the ¼-inch coil. I keep a number of both sizes in stock. By measuring the force of different lengths of this 0.020-inch diameter coil, I find that ⅜-inch spring compressed $\frac{1}{32}$ of an inch will exert a force of two ounces. When compressed $\frac{1}{16}$ of an inch it will exert a pressure of four ounces. The ¼ inch compressed $\frac{1}{32}$ of an inch exerts a pressure of two and one-half ounces, and if it is compressed $\frac{1}{16}$ of an inch, the pressure is doubled, that is, a five-ounce force is exerted.

The $\frac{1}{16}$-inch coils are threaded on the midsection of the twin-arch as spare parts. For instance, after the force of $\frac{1}{4}$-inch coil has moved the teeth, the locks are removed and the $\frac{1}{16}$-inch coil is added to the $\frac{1}{4}$-inch coil-spring so that the pressure can be continued without making a new arch. In other words, the $\frac{1}{16}$-inch coils serve somewhat as spring washers.

The study of spring force is very interesting. From my studies I have found that the following factors govern the amount of force a coil-spring exerts:

1. The alloy from which the spring is made. For instance, a precious metal spring is about one-half as efficient as a steel spring made from 8-18 steel alloy.

2. The diameter of the wire from which the spring is made. For instance, a 0.007-spring will not exert as much force as a 0.009-inch wire if they are both wrapped on the same size core.

3. The size of the core or wire on which the spring is wrapped. For instance, if two springs of the same gauge wire are wrapped, one on a 0.032-inch wire will not exert as much force as one wrapped on a 0.020-inch wire.

A.

B.

C.

Fig. 11.

4. The length of the spring. For instance, a one-inch spring of 0.009 inch compressed $\frac{1}{16}$ of an inch will exert one-half as much force as a one-half-inch coil of the same gauge when compressed the same amount.

5. A spring that fits a bar so tight that it binds will not exert as much pressure as one that does not bind.

When I began using the twin-arch I was surprised to discover the rapidity with which it moved the teeth. It made me wonder how much pressure I was exerting with it. After some experimenting I found the most satisfactory and accurate scale for measurement of this force was the postal scale sold in stationery stores—scales made for weighing letters to determine the postage re-

quired. They show weights from one to several pounds. I found the one-pound scale the most convenient to use. I removed the platform and screwed a cone and socket amalgam instrument in its place. To the side of the amalgam point I soldered a tube to measure the force of springs (Fig. 12*A*). By using this simple attachment I have devised an accurate, inexpensive scale that will measure the force of any appliance used in orthodontics, such as fingersprings on lingual appliances, the pressure of arch-wires (both twin-arch and other varieties), coil-springs, rubber bands, etc. In fact, I think that with it I can measure the force of practically any appliance that may be used in the moving of teeth.

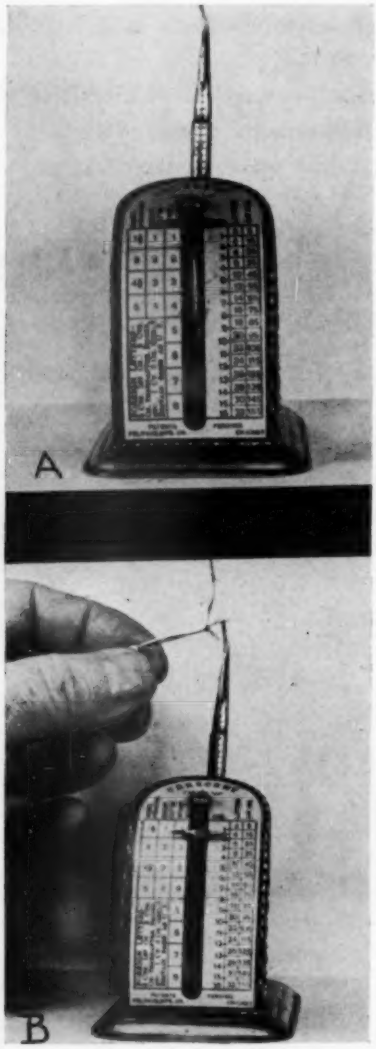


Fig. 12.

The natural inclination of a tooth is to move forward in the arch. This is especially true of molars and premolars. When a deciduous molar is lost, or its contact destroyed, the first molar will invariably drift forward to close the space.

I have heard many good orthodontists say that they do not believe molars can be moved distally. Such statements have always seemed strange to me, for I have been moving molars distally many years.

I discovered in my arch predetermination with amalgam models that if I moved the molars distally, it was not necessary to widen the arch very much to make room for aligning the teeth. I found it about this proportion: if I moved a molar distally $\frac{1}{16}$ of an inch, I obtained as much space to align the teeth as if I had widened the arch $\frac{3}{16}$ of an inch.

When I am ready to move a molar distally, whether unilateral or bilateral, I remove the lingual appliance on the molars to be moved. I also see that my molar buccal tube and the locks on the anterior bands are in the same plane. In other words, I find that, when the end tube of the twin-arch is in the buccal tube, the twin-wires lie passive in the locks on the anterior bands without the end-tubing being bent up or down.

I next select two 0.009-inch coil-springs that have been stretched and compressed to a half-inch length. A spring of this length and gauge, when compressed $\frac{1}{16}$ of an inch, will exert a pressure of three ounces. They are placed over the end tubes of the twin-arch. The twin-arch is locked on the anterior teeth. I now make a stop on the end tube in order to compress the spring against the end of the buccal molar tube. This is done with a round-beak pliers. As already stated, I prefer the pliers called the Young pliers. The beak of the pliers is placed in front of the coil and is slid along the tubing until the coil-spring has been compressed $\frac{1}{32}$ of an inch or about the width of the beaks of the pliers. The beaks are then compressed, thereby flattening the end tubing. This makes an effective stop (Fig. 11*B* and*C*). The most important thing to remember in this operation is not to compress the spring too much and not to exert too much pressure on the molar, for if moved too fast, one is sure to tip it when it is moved back.

At the patient's next visit it is not necessary to remove the twin-arch to tighten the springs but merely to take the Young pliers and compress the tube another $\frac{1}{32}$ of an inch or the thickness of the beaks of the pliers.

Now, as we all know from our study of physics, that for every action there is an equal and opposite reaction. In other words, when we apply pressure to the molars, we are at the same time exerting an equal amount of pressure on the anterior teeth. And we know the anterior teeth move forward much more readily than the molars do distally. So in order to counteract this force we must apply the use of intermaxillary rubbers. If I am exerting three ounces of pressure on the molar to move it distally, then I use an intermaxillary rubber with a pull on the maxillary anterior teeth of four ounces, on each side, to prevent the anterior teeth from moving forward. The method I have just described is very effective. By actual measurement I have moved a molar distally as much as $\frac{3}{8}$ of an inch. The top models in Fig. 13 are good examples of the distal movement of a molar. In this instance the deciduous molar was lost early, due to the first molar being impacted. I deliberately moved the molar back too far (middle model) in order to give the second premolar, which was impacted, sufficient room to erupt. The third model shows the results after all retention had been removed.

I am often asked what happens to the second molar when the first one has been moved backward. In most cases nothing happens, because the second molar usually comes in where it should. If it does not erupt normally it

will come in buccally, as shown in the lower models of Fig. 13. If it does, when I construct my retaining plate I extend a 0.036-inch finger-spring between the first molar and the second premolar and let it rest against the second molar as in the right lower model. With a few adjustments of this finger-spring the molars are moved down in place. After three or four months this spring can be cut off. The cheek muscles and the occlusion prevent the molar from relapsing. When I am ready to let the spaces close up between the molar and the premolars, I trim the vulcanite in the interproximal spaces and the teeth close up, as in the top models of Fig. 13.

If the third molar erupts buccally, I have it extracted.

If I wish to move a mandibular molar distally, I use the same technique just described to move the upper molar back except I reverse the pull of the intermaxillary rubbers. Lower models in Fig. 14 show a case of this type; the lower molar was moved distally ¼ inch.

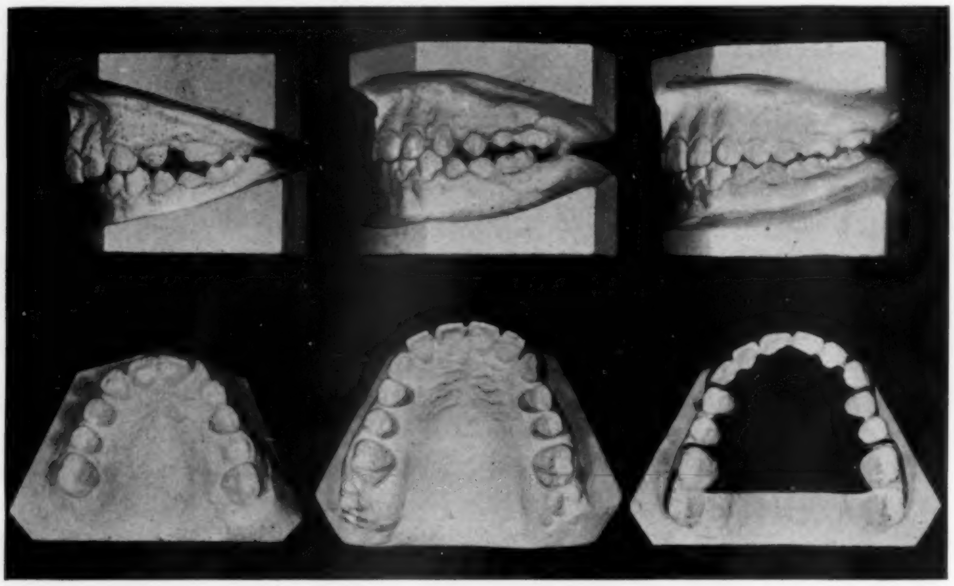


Fig. 13.

The twin-wire appliance also works very well for moving a molar forward. I banded the first molars and the incisors and used an intermaxillary rubber from the hook on the twin-wire arch to the tube on the maxillary molar. This force will slide the premolars and molar forward, as shown in the upper models (Fig. 14).

I wish to emphasize the following facts about the use of the appliances referred to:

1. Simplicity in construction and operation.
2. The appliance is easy to keep clean.
3. It has no sharp or rough parts to irritate the lips or tongue.
4. Despite its fragile appearance it is strong and is seldom broken by the patient.
5. It is neat looking.

6. The pressure which is light is constant and continues to work over long periods of time and produces as near a physiologic tooth movement as it is possible to produce with an appliance.

7. The teeth are moved automatically to normal arch form, for when the twin-wire arch is placed in the molar tubes it assumes the shape of a normal dental arch. However, this does not mean that all my arches have the same shape.

8. I can move a tooth in any direction in which it is possible to move it—be it labial, lingual, mesial, distal, elongation, depression, rotation, tipping or bodily movement. I do not advocate the use of the appliance to gain expansion in the premolar and molar region. This can be accomplished better with a lingual appliance.

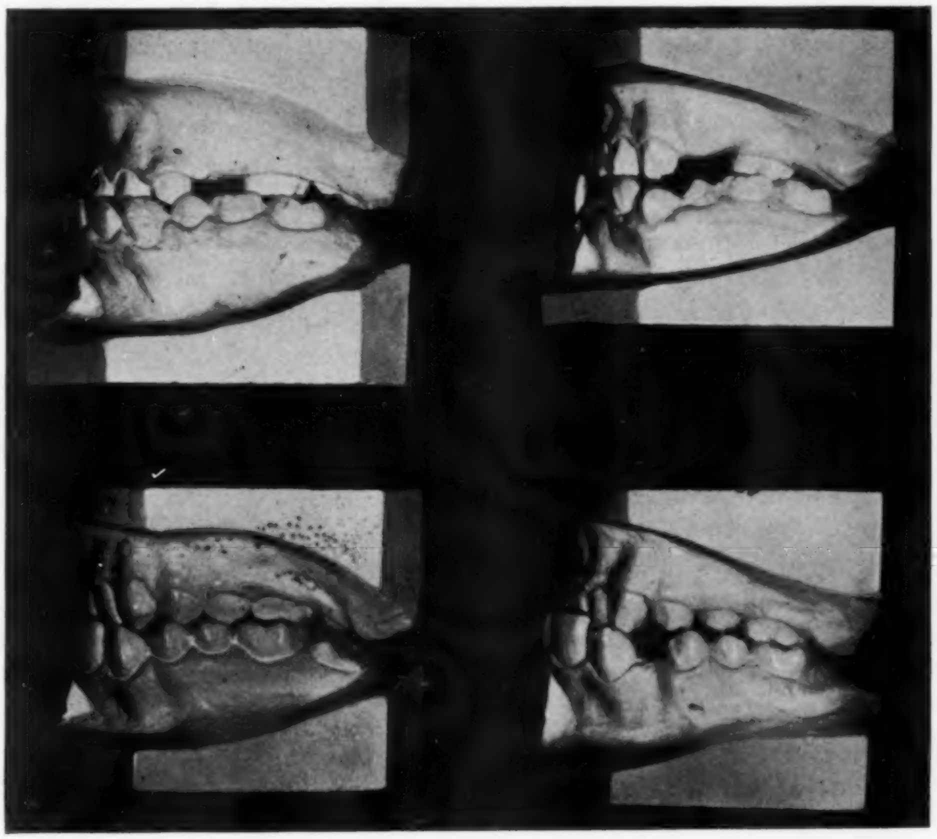


Fig. 14.

9. Root as well as crown movement are automatically obtained.

10. Teeth are moved rapidly without discomfort and with no injury to the tissue.

11. The force of the mechanism is under complete control of the operator.

12. Bite planes are eliminated. In fact, in my office, bite planes are considered as obsolete as the Model T Ford, except when used on a Hawley retainer.

Department of Orthodontic Abstracts and Reviews

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The Treatment of Lingual Occlusion of the Maxillary Incisors With Nickel Silver and Stainless Steel Appliances: By C. A. Tinn, H.DD.D. Edin., L.D.S. Eng., *British Dent. J.* **69**: 424, Dec. 16, 1940.

This paper gives a survey of thirty-eight cases treated with fixed appliances of the simplest type. The materials used were nickel, silver, and stainless steel.

Four types were used: (1) the incisor coiled spring appliance; (2) the vertical half-round tube on the incisor band with labial wire extending to adjacent teeth; (3) the lingual cantilever spring; (4) the lingual arch with auxiliary springs.

The incisor coiled spring appliance was used for the treatment of single incisors in lingual occlusion, the spring being formed of gauge 24, hard, stainless steel.

Twelve cases were treated with this appliance. The ages of the patients ranged from 8 to 13 years, and the treatment was completed in from one to six weeks (average 3 to 6 weeks). Natural retention proved sufficient except in one case, which had only a slight overbite. This relapsed slightly, but was corrected by trimming the occlusal planes so that biting exercises were sufficient to retain the tooth in its correct position.

The vertical half-round tube on the incisor bands was used in only three cases. It was tried as a simple modification of the incisor coiled spring appliance, but it was not so effective as the former appliance. In this case, gauze 24 stainless steel was used, in the other two treated cases, gauge 21. The latter proved too rigid and the thinner wire was preferable. As will be seen $\underline{1|1}$ were in lingual occlusion with $\underline{2|2}$ in labio-version. The appliance was reciprocal in action, moving $\underline{1|1}$ over the mandibular incisors while retracting $\underline{2|2}$ in two weeks, but further alignment of $\underline{21|12}$ was necessary, so the appliance was worn for a further ten weeks. The other two cases treated with this appliance required the labial movement of only one maxillary central incisor in each case, and took five and six weeks for the completion of treatment.

The lingual cantilever spring was made of stainless steel, gauge 21 or 24, and was anchored to a maxillary first permanent molar and a first deciduous molar, or a first permanent premolar. It was used for the labial movement of

one or more maxillary incisors. In two of the four cases treated with this appliance an incisor band carrying either a spur or a split tube to hold the spring in position, was used. With the thinner gauge of wire such a stabilizer is essential, and it increases the efficiency of the appliance.

The time taken for the treatment of these four cases varied from three weeks to a maximum of nine weeks (average six weeks), the ages of the patients being from 9 to 11 years.

It proved most suitable in the broad flat type of arch, in which it is quite stable. The opposite side of the arch being left free for mastication minimizes the possibility of dislodgment, and adds to the comfort of the patient.

The lingual arch, of gauge 21 stainless steel, was used for the majority of the cases, nineteen. It was anchored to the maxillary first permanent molars and was used either alone or more frequently with one or two auxiliary springs of gauge 24 stainless steel. Treatment took from three to twenty-four weeks, the ages being from 7 to 12 years.

Artificial retainers were never found necessary. It has always been found sufficient to correct the irregularity and to instruct the patient to bite in the correct position.

Complications occurred in only one case, where acute periodontitis of $\underline{1|1}$ followed shortly after the insertion of the appliance, due to the initial pressure of the auxiliary springs being too great. The removal of the lingual arch and treatment with counterirritants allayed the inflammation. It was reinserted a few days later, and treatment was completed. Later pulp tests on $\underline{1|1}$ confirmed normal vitality.

The rate and ease of tooth movement appear to be mostly dependent on individual biologic factors which involve the complex mechanism of bone absorption and deposition, but are favorably influenced by age in that younger patients have incomplete root formation and maximum metabolic activity, so favoring the osteoplastic changes necessary to physiologic tooth movement. The incipient tendency of some maxillary incisors to erupt in lingual occlusion, if observed during the eruptive phase, can often be corrected by simple exercises, either with the finger or with a narrow strip of pink baseplate gutta-percha on which the patient practices gentle biting exercises designed to guide the tooth into its correct position. Should such measures fail to correct the irregularity, an appliance can be used later.

Value of Autosuggestion on the Therapy of "Bruxism" and Other Biting Habits: By Paul J. Boyens, D.D.S., *J. A. D. A.* **27**: 1773-1777, November, 1940.

Traumatic occlusion is quite generally a potent factor in both gingivitis and bone resorption. The general interpretation in this connection is that trauma occurs in eating, but it has long been recognized that the real trouble occurs from clenching or grinding during sleep, or unconsciously while awake, and is variously known as *Karoli* effect, *stridor dentium, bruxism* and *occlusal neurosis.* The last term, used by Tischler, is perhaps the most explanatory.

"Bruxism," as used in this article, may be defined to include inaudible clenching, audible gnashing, cusp tripping and abnormal contacts made during the most extreme and unsuspected mandibular excursions.

Bruxism is present more than is realized by the average person. Almost 100 per cent of patients, when asked about it, honestly think they do not have this habit.

Often patients complain that their teeth are sorest in the morning, and others complain of bleeding at night. Sore teeth in the morning and bleeding at night indicate "sleep biters." Almost 100 per cent of those having some form of periodontal disease are or have been addicted to bruxism in some form.

This habit is not confined to the hours of sleep alone; many indulge in it while they are awake. The causes seem to be varied, any physical discomfort (including dental) or mental unrest may be a cause. It would not be humanly possible to remove all the potential causes in a given case.

Correction of unconscious habits takes one into the field of applied psychology. Instead of having the patient make a negative suggestion, such as "I will not bite my teeth," I tried a suggestion in the affirmative: "I will awake myself when I bite my teeth." This suggestion seems to be most effective when used by the patient just when he is about to drop off to sleep. The reason for this is that, in this twilight zone between waking and sleeping, the active, conscious mind is in abeyance so that suggestions may be planted in the unconscious mind with the idea that there shall be postautosuggestion phenomena.

Autosuggestion involves the repetition of a fixed and positive thought, worded in such a manner that the unconscious reaction is one of harmony and in accord with conscious demands. Autosuggestion must not be confused with psychoanalysis, which has to do with the uncovering of impressions, ideas, and concomitant emotions, already buried in the unconscious.

Once the patient becomes convinced that he has been doing something he was not conscious of, his attitude changes from doubt to curiosity and interest. He then becomes more willing to cooperate wholeheartedly.

The next step then is for him to use the suggestion, "I will awaken if I bite or clench my teeth," just before going to sleep, and to repeat it whenever he awakens, from whatever cause. Some psychologists may suggest different wording for these affirmations.

It is well to have the patient augment his reactions on awakening by the simple affirmation, "I will relax."

Among the most significant observations are the decreasing sensitiveness and improved tissue tone of these patients who reacted satisfactorily from the psychic point of view. Those who had sore teeth or tired jaws upon awakening, or had spontaneous bleeding during sleep, were grateful for relief.

Discovery by the patient of his own unconscious biting or clenching habits during waking hours is of great diagnostic value and is often the first step toward his becoming conscious of certain benefits; his corrective habits, with a little urging, automatically tend to perpetuate themselves.

The Medical Management of Fractures: By Charles F. Nelson, M.D., and Roland C. Nelson, M.D., *J. A. M. A.* **116**: 184-189, January, 1941.

The authors have presented a most interesting article stressing the importance of routine medical examination and management in all cases of fractures. Their findings are based first on the study of approximately 1,000 fresh fractures treated over a period of five years without a failure in union; secondly on several cases of forced regeneration by medical management where there was a greatly delayed union, osteoporosis, Paget's disease, or fragilitas ossium and, thirdly on animal experimentation.

They feel that the specific factors governing bone metabolism are calcium and phosphorous concentrations of the serum, the calcium and phosphorous ratio of the serum, activity of the parathyroid gland, and vitamin D levels.

Early bone chemistry determinations for calcium and phosphorus should be made in order that accurate medical management may be instituted without delay. They feel that optimal levels of blood calcium should be between 10.5 and 12 mg. per 100 c.c. and of blood phosphorus between 3.5 and 4 mg. per 100 c.c. with a ratio of 3 calcium to 1 phosphorus (3 to 1).

After extensive studies they are also of the opinion that the levels of serum calcium and serum phosphorus can be controlled by medication and diet and that reports to the contrary are erroneous. The medical management of these cases is fully described.

The part played by the parathyroids on calcium and phosphorous metabolism is also discussed. The effect of therapeutic doses of solution of parathyroid in the treatment of almost 1,000 fractures leads to the following observations:

1. It increased the excretion of phosphorus in the urine.
2. It assisted in the proper utilization of diffusible calcium.
3. It probably made some of the nondiffusible calcium available.
4. It stimulated osteoclastic followed by osteoblastic activity in bone.

They also noted that vitamin D increased the serum phosphorous concentration more rapidly than the serum calcium resulting in a low serum calcium-phosphorous concentration ratio. They felt that this might produce nonunion and that the promiscuous use of vitamin D, especially Viosterol, may be dangerous. The administration of vitamin D from 2,500 to 3,000 units daily in cases of fracture with a low phosphorus was recommended. In those cases with low calcium this treatment was not recommended.

They also called attention to the fact that a normal amount of free hydrochloric acid in the stomach is necessary to assure the absorption of calcium and phosphorus in the small intestine. In connection with this they advised warning the patient against the excessive use of citric acid fruit juices, bicarbonate, citrocarbonate, and other alkaline powders.

In the cases of osteoporosis or an acromegalic type of bone a basal metabolism and the administration of thyroid thus indicated should be undertaken.

These observations are most interesting and enlightening. They should prove helpful to the oral surgeon in the management of fractures.

T. Kaletsky.

A New Plaster: *Science* **93**: 19 (Feb. 21), 1941.

Though chemically the same as plaster of Paris, a new gypsum plaster, described at the meeting of the American Institute of Chemical Engineers, is about twice as strong as the old-fashioned article. In fact, it approaches Portland cement in strength. The new product was announced by E. P. Schoch and William A. Cunningham, of the University of Texas. It is prepared by heating gypsum in a magnesium sulfate solution, whereas plaster of Paris and ordinary wall plaster are made by the dry calcination or burning of gypsum. Experiments in a small pilot plant indicate, they stated, that it can be made at a cost of $8.82 per ton, a figure that may be reduced by large-scale production. Probably the magnesium sulfate plaster will find its chief application in wall board, tile and other factory cast products.

Rumination as a Cause of Perimylolysis: By Finn Lange, *Acta Odontologica Scandinavica* **2**: November, No. 2, 1940.

A case is reported in which the crowns of the maxillary teeth have undergone chemical abrasion on the lingual and occlusal surfaces. The patient has developed the habit of regurgitating his food and pressing it with his tongue against these tooth surfaces. During the sour eructations the pH of the saliva is reduced from 7.2 to 3.7 which rises in twenty minutes to 6.3. The surfaces affected are smooth and therefore the process cannot be purely chemical.

With these facts in mind the author concludes that the degenerative process is caused partly by a chemical process due to acid eructations and partly by a mechanical process involving motions of the tongue.

L. L. Taft, D.D.S.

The Psychology of Nervous Habits: By Rachel Sclare, L.D.S. (Leeds), *Dent. Record* **60**: 439, November, 1940.

Most of our patients are laboring under some emotional stress when they come to us for treatment, and in endeavoring to inspire confidence and so carry out the necessary treatment successfully, the dentist is unconsciously practicing psychology.

Thumb-sucking along with other habits such as stuttering, nail-biting, and enuresis are classed as nervous habits, and are all symptoms of an emotional state; they are the malresponses to emotional situations, based on conditions of anxiety, insecurity, inferiority, and tension.

It is therefore necessary to consider the child's environment, his relation to his parents, his brothers and sisters, and other persons in the house, and the parents' attitude toward each other and to the child. If unity between the

parents is lacking, if they are constantly quarreling with each other and there is lack of harmony in the home, the only anchorage he knows is gone, and the child will develop a feeling of insecurity and anxiety. On the other hand it is not wise for parents to indulge in lovemaking in front of the child. This is particularly so in the case of boys. The identification with the father, which is the chief aim of the little boy, and the most powerful impulse toward his masculine development has its roots in two simultaneous, contradictory and ambivalent attitudes of the little child to the father: the one hostile and the other loving. Where the hostile attitude prevails and the child feels himself outrivaled he may resort to some irritating nervous habit in order to draw attention to himself or as a means of consolation.

In a home in which parents maintain a stern attitude toward their children, in which strenuous punishment is used for comparatively minor offenses, the child is likely to develop a generalized feeling of insecurity. He is kept in a state of infantilism long after he should have passed this stage, and the attempt to maintain this state is the basis of many of the so-called nervous habits.

When a child, who has been an only child for a number of years and the center of his mother's attention, is suddenly presented with a baby brother or sister, he may feel that his mother has betrayed him. One of the first pleasures experienced by a child is that of sucking; so the child, feeling himself neglected, finds his gratification in sucking his thumb. The action of thumb-sucking is determined by the fact that it seeks a pleasure which has already been experienced, and is now remembering.

In the early stages occasional sucking of the thumb should not be considered a problem. In a small number of cases the habit may be congenital. More often it is closely associated with the infant's original feeding methods, i.e., sucking at the breast or bottle. Each nursing period begins with the child tense and restless because of hunger. As the nursing continues he becomes relaxed, and after a fully satisfying meal he is sufficiently relaxed to fall asleep. If for some reason—physical conditions, inadequate diet, hurry or emotional disturbances, the child is not fully satisfied, he may suck his thumb or fingers, until he has fallen asleep. There can be nothing seriously undesirable about his form of behavior provided it does not become chronic. Treatment in such cases consists in correcting the underlying nutritional cause. The custom of weaning a child from the breast when it is eight or nine months old may also be responsible for this habit. In this connection it is interesting to note that among children in primitive societies where the period of suckling is prolonged until the child is from two to three years of age, thumb- and finger-sucking is unknown. Havelock Ellis suggests that thumb-sucking may be an infantile form of masturbation.

It is very doubtful if mechanical contrivances on fingers, or splints on arms aid as much as they interfere, for they are liable to focus attention upon the arm or hand which is already associated with the response. With older children an appeal to pride and vanity may prove effective.

The appeal to vanity has also proved an effective means of curing nail-biting. Children who indulge in this habit should be encouraged to manicure their nails. This not only helps to instill them with pride in their nails, but by removing the rough pieces of skin and rough edges around them, the attention is less likely to be called to them. This method was tried at a clinic in America. A course in manicuring was started and every girl was taught how to manicure, and then they manicured each other. One of the first questions asked when a girl came to the clinic was, "Let me look at your fingernails." Nail-biting was soon stopped.

The general treatment consists in bringing about a satisfactory readjustment of the individual to his environment.

Book Reviews

Complete Dentures: By Merrill G. Swenson, pp. 736, 905 illus., St. Louis, 1940, The C. V. Mosby Co.

Those who have felt the need for a prosthetic specialist at their elbow when working on a difficult case can now have such consultation. Swenson's book gives the general practitioner the opportunity of having a constant reference and is almost as good as having the author as an office associate. Swenson has contributed to dental literature a book on *Complete Dentures* which is the most notable work in the field of prosthetics published up to the present time. In this text we have a permanent and continuous postgraduate course that teaches through its photographs and explains through its text. It is a book that should be on the must list of every general practitioner if he wants to render better service.

The book is divided into the following parts: "Construction of Complete Dentures"; "Immediate Denture Construction"; "Related Factors of Complete Denture Construction"; "Supplemental Procedures and Materials"; and "Single Maxillary Dentures and Rebasing." Swenson believes in showing us how to do things. He takes us step by step through procedure and his illustrations follow each other so logically that any dentist can feel confident he will not "go wrong" along the line. It is remarkable how practical procedure can be simplified in this book. His chapter on "Materials" should be particularly helpful to the general practitioner. This is presented in a straightforward manner and does away with much confusion because of various conflicting claims.

Immediate dentures are considered from the point of view of the dentist who is confronted with a patient who needs them and must have them "now." The part devoted to laboratory procedure should promote clarity and simplicity on a subject that too many schools take for granted and too few dentists know anything about.

The descriptions of articulators and explanations of occlusion avoid a maze of technicalities and place these two subjects in the realm of practicability where they belong.

Waldo H. Mork.

Applied Orthodontics: By James David McCoy, M.S., D.D.S., F.A.C.D., Associate Clinical Professor of Surgery (Oral). School of Medicine, University of Southern California, Los Angeles, California; Formerly Professor of Orthodontics in the College of Dentistry. University of Southern California, Los Angeles, California. Fifth Edition, thoroughly revised, published 1941. Octavo, 333 pages, illustrated with 227 engravings and a plate. Cloth, $4.50 net, Lea and Febiger, 1941, Philadelphia, Pa.

McCoy has revised his book in keeping with present knowledge and practice. In the brief and concise style for which the author is known, he discusses applied orthodontics from the standpoints of etiology, diagnosis, and treatment. "Orthodontics," says McCoy, "is a study of dental and oral development; it seeks to determine the factors which control growth processes to the end that a normal functional and anatomical relationship of these parts may be realized, and aims to learn the influences necessary to maintain such conditions when once established." The foregoing is of course a far cry from the "tooth straightening" concept of orthodontics. It properly takes orthodontics out of the hands of the mechanic and places it in the care of those who see this specialty as one concerned with problems of growth.

It should not be interpreted from the foregoing that this book does not concern itself with appliances and their construction. The various types of appliances are discussed and illustrated in detail.

McCoy may be accused by some of oversimplifying the etiology of malocclusion. The fact remains that his analysis of the causes of malocclusion is not only practical but provides a basis for the prevention of dentofacial anomalies and the treatment of incipient malocclusion. There is no reason for anyone to feel that dentofacial anomalies are of some mysterious origin. As pointed out by McCoy, such anomalies are in many instances sequelae of local interferences which, if removed, frequently remove also the malocclusion without further treatment.

In this chapter on "Elements of Modern Appliances," the author discusses arch wires, anchor bands and attachment bands. The use of the McCoy open tube attachment is explained in detail.

Retention and muscle training, as advocated by Alfred P. Rogers, are described. It is pointed out that normal muscular action is a prerequisite to successful retention of treated cases. The illustrations of this book are examples of simplicity and can be followed with ease.

J. A. Salzmann.

Twelve Periodontal Studies: By Harold Keith Box, University of Toronto Press, Toronto, Canada, 1940, $2.50.

"Twelve Periodontal Studies" is a modest title for Dr. Box's latest contribution to periodontal literature. The book, developing each phase of periodontology from the physiology of the oral cavity through the treatment of all phases of periodontal disease, ends in a consideration of caries immunity. The material is characteristic of the unique position of researcher and clinician

held by the author in the field of periodontology. It is neither of the theoretic laboratory nor of the empirical practice, but is the result of the scientifically sound balance of both. This quality gives the book the scientific validity so essential for the practical demands of periodontology. Nor does Dr. Box limit his viewpoint to those branches of the work that have come from his own office or laboratory—his catholic view of the field as a whole has given his book a breadth of approach rarely seen.

Of special aid in the diagnosis of periodontal diseases are the studies on "Wear," "Heavy Function," "Lack of Function," and "Traumatogenic Occlusion and Articulation." The author's work on the effects of traumatogenic occlusion establishes this factor in the etiology of periodontal disease with a finality that obviates any doubt concerning the need for occlusal adjustment in treatment. Focal infection disease as a result of periodontal infection is another point which is definitely established as a verity worthy of serious consideration.

The chapter on periodontal therapeutics, "The Prevention, Cure and Control of Periodontal Diseases," the chapter on their management, and that of necrotic gingivitis furnish the means for successful treatment.

While much of the material has appeared in brief articles in dental publications and in the bulletin of the Canadian Dental Research Foundation, the presentation here is complete, direct and unselfish in the author's effort to make the book a clear and easily applicable outline of the methods he has found of value.

Everyone interested in the periodontal diseases (which cause the loss of more teeth than all other factors combined) will improve his work through a study and application of the teachings and techniques set forth in *Twelve Periodontal Studies.*

J. Lewis Blass, Ph.G., D.D.S.

Dental Formulary: A Practical Guide for the Preparation of Chemical and Technical Compounds and Accessories as Used in the Office and Laboratory by the Dental Practitioner With an Index to Oral Diseases and Their Treatment: By Hermann Prinz, A.M., D.D.S., M.D., Sc.D., Dr. med. dent., Emeritus Professor of Materia Medica and Therapeutics, the Thomas W. Evans Museum and Dental Institute, School of Dentistry, University of Pennsylvania, Philadelphia, Pa. Sixth Edition, thoroughly revised, published, 1941. 12 mo., 352 pages, Flexible binding, $3.50, net. Philadelphia, Lea and Febiger, 1941.

The author had made all the necessary changes in the recipes to conform to present standards of the enumerated pharmaceutical and technical compounds. Those preparations which have become of less importance to the dental practitioner and allied readers have been discarded. Each formula specified in this book may be regarded as representing a basic compound to be employed as such or modified to suit the conditions at hand. Most of these formulas, how-

ever, especially those of a technical nature, represent the practical experience of men of mature judgment who are known as experts in their respective fields.

Prinz's *Dental Formulary* is one of those books which are indispensable to the man who likes to do things for himself and is not merely satisfied to follow the beaten path. The savings effected in using this book will be found worth many times its cost.

Child Care and Training: By Marion L. Falgre, Assistant Professor of Parent Education, and John E. Anderson, Director, Institute of Child Welfare, University of Minnesota. Fifth Edition, Revised. Pp. 320, Price $2.50, Minneapolis, The University of Minnesota Press, 1940.

This book should be of interest to those whose professional activities are devoted to influencing the physical appearance of children: orthodontists belong to this category. In the chapter on "Physical Growth and Development of the Child," the authors stress the factor of individual variation. Height and weight tables are provided. The part dealing with teeth is presented in language understandable to laymen.

The question of thumb-sucking is discussed from the psychologic angle and sound advice is provided for those whose concern it is to break this habit. This book is a practical guide for parents as well as teachers, physicians, orthodontists, and all others concerned with the child.

Editorial

Appliances Past and Present

Lillian Russell was the world's favorite actress, and the World's Fair was in progress in Chicago in 1893; a few years later Teddy Roosevelt led his Texas cowboys up San Juan Hill. To ride a bicycle inspired more pride than owning a twelve-cylinder streamlined car in this year of 1941. That was the era in which the first important impetus occurred in modern orthodontic history, the period in which orthodontics first saw the light of day.

Clamp bands made of base metal were invented—those with the screw thread on the lingual and those with the thread on the buccal side. The Angle clamp band was the best known (with the screw thread on the lingual); the Lukens and Brady bands exemplified the type that incorporated the screw thread with the combination of the buccal tube all in one and the same unit. Contention was rife and even bitter in some quarters as to the relative merits of these two types of clamp bands. As for the Magill band in that particular day, it became temporarily eclipsed. Those who advocated the lingual screw post type claimed that clamp bands must be fitted carefully to place and that no small amount of care must be exercised to keep the screw post from projecting toward the tongue; and that the screw post should be adapted close and in contact with the lingual surface of the premolar teeth in order to be efficient and nonirritant to the side of the tongue.

Those who advocated this lingual screw post type of clamp band maintained that the Lukens and Brady bands, with their buccal tube and screw post ensembles, were of no value in application; it was said to be impossible to align the buccal tube parallel with the leg of the labial arch wire with this band, thus causing complex anchorage difficulties in treatment that diverted appliance energy out of the same plane of application, like an airplane with its wings nonparallel.

Those who advocated the buccal tube and screw post type in combination were, in turn, loud in their condemnation of the lingual screw post regardless of technique in practical application; they said it could usually be found to be a source of chronic irritation to the tongue of the patient during treatment, all claims to the contrary notwithstanding.

This was the day as well of German silver and brass expansion arches, with their various modifications. Those who used German silver saw their appliances turn an unsightly black with oxidation in the mouth, but could do little about it. Those who were using brass under various trade names heard their patients complain on periodical visits about chemical reactions with the saliva and of a "brassy" taste every time they enjoyed a helping of eggs in the morning. To be charitable, however, most operators did not know that they were using brass at the time; they thought it was some secret formula of

the metallurgists, that would not oxidize easily. The solder used for these base metal appliances was plain soft jewelers' solder; nothing better could be found because solder that required a high temperature in order to flow would break down the elasticity of the arch wire and destroy its usefulness entirely in treatment.

Of that day, as well, was the use of Jackson removable appliances advocated by Dr. Victor Hugo Jackson, and they were made entirely of bulky base metals. They attained little popularity among orthodontists, however, in the main because the patient could remove them. Accordingly this limited the Jackson technique to a highly restricted group of cases in which shifting of occlusal relations was not required in treatment, and unfortunately the Jackson removable technique was seized upon by the mail-order type of orthodontic practice because it lent itself to "appliance-on-the-model" construction and mailing out, a system of practice orthodontists have never regarded as other than a mere gesture in correction of malocclusion, as compared with modern and finished methods.

In retrospect, the above are only a few of the many controversial mechanical subjects of the past. Now, fortunately, they can be passed off with a shrug of the shoulder and regarded as growing pains, but at one time these arguments were just as serious in their implications as are the arguments of the advocates of various types of mechanical techniques in 1941 and no less important in earnestness of discussion.

Times changed, and technique and material changed. Along came the precious metal era. The technique was much the same, but he who remained with the base metal technique was thought by many to be behind the procession of orthodontic advance.

Then came the working retainer with the all precious metal pin tube appliances. Their life, in general, was enthusiastic but short in popularity. Then emerged the ribbon arch as a proposed improvement over the pin tubes. With it came many, many advocates, and along came the Mershon technique with an entirely different approach to the mechanical and biologic problem of orthodontic procedure. The tiny ribbon arch of Angle followed, and then there came, with quite a wide following, the Johnson twin wire and numerous others. All along the way there have been many modifications of all of these basic techniques, followed by various degrees of success by numerous operators. Any modified technique of the basic concept is usually soon labeled by the name of the man who originated the modification and placed it in use.

Some have had the opportunity to visit various offices of those who secure excellent results with all of the basic mechanical devices mentioned. All the way from the base metal, grass line, and wire ligature epoch up to the present it has been equally important and interesting to observe gross failures as well as successes by the use of all techniques above described; so successful practice, it would seem, requires skill, experience, precision, patience, and an orthodontic sixth sense, the kind of appliance notwithstanding in the end result.

Change is happening now with incredible speed, faster than ever before in history. The tempo of both thought and action is in rapid transition in every line of human endeavor as never before. Thousands who were world-

beaters yesterday in some particular activity of life are rated as has-beens today because of the fast-shifting scene.

No doubt, orthodontics, having an important technical mechanical development of fifty years of background, is changing faster than we know. It may be well now to become more change-minded with this transition, but it is to be recalled that for every new step you take, you have to abandon old prejudice and intolerance, old sentiment, resistance, old ways of doing and feeling. There is no such thing as a permanent life ticket to a given destination. Some men are treating malocclusion and getting results with vastly more dispatch, efficiency, and less folderol than they did five years ago. That is progress and cannot be dismissed by a shake of the head or "It can't be done" attitude, because it is done.

Let's watch the orthodontic change that's taking place. Perhaps ten years from now the present-day methods will be referred to with a shrug of the shoulders, much as are the German silver days of the gay nineties at the present time. You will go on, so don't be oblivious to change and progress; it's happening in orthodontics as well as in the machine shop or the map of the world. Keep change-minded; to be otherwise now is to be out of step with the times. It requires a fine technician to correct malocclusion with dispatch and efficiency. Regardless of how much we find out is not yet known about malocclusion problems, there will always be a place for the highly trained orthodontic technician. It is part of the job of successfully correcting malocclusion, and to discount it too much in practice in the opinion of many can be regarded as too much wishful thinking.

H. C. P.

Special Article

A Personal Tribute to Horace Leonard Howe, 1875-1941

LAWRENCE W. BAKER

Dr. Horace Leonard Howe, Professor of Clinical Orthodontia in the Dental School of Harvard University, an eminent authority and skilled practitioner in the treatment of deformities of the face and jaws, died Feb. 1, 1941, after a brief illness. He was in his sixty-sixth year.

Dr. Howe was of distinguished ancestry, being a direct descendant of Henry Dunster, the first President of Harvard College. Among his other forebears may be counted Levi Woodbury, a United States Senator and Governor of New Hampshire. To the former may be attributed his interest in education, to the latter his public spirit. Undoubtedly, he inherited his interest in medical subjects directly from his father, a physician, and who, in turn, came from a strong medical family.

HORACE LEONARD HOWE

Dr. Howe was graduated from the Harvard Dental School with the class of 1898. He soon took a deep interest in dental education, joining the orthodontic teaching staff of the School in 1906, serving continuously to the present, a period of 35 years. Because of his broad knowledge of this subject, his teaching ability, and his marked enthusiasm as well as his sterling character, he was put in charge of the clinical orthodontic department, serving with the rank of Clin-

ical Professor since 1931. Among his other activities he served for many years as a staff member of the Forsyth Dental Infirmary for Children, where he rendered distinctive service in the orthodontic department.

He was born in Lancaster, Mass. His father, however, soon moved his family to Hollis, N. H., where he served the community as a country physician, living on a village farm. It was in this beautiful New England town that our Dr. Howe spent his impressionable boyhood. Undoubtedly it was his close contact here with nature that developed his sturdiness, resourcefulness, and capacity for hard work, all of which so essentially contributed to his later success in life. Dr. Howe was firm in his belief that to succeed truly in any branch of the healing art, including dentistry, one must be at heart a naturalist. While he himself had naturalistic instincts, he made no claim at being an investigator; nevertheless, his teachings and writings showed that few of his colleagues had such ability to evaluate and make practical the application of both physical and biologic research. It was a great satisfaction for him to live to see his much-criticized theory as to the treatment of disharmonic head and face-form cases accepted by the orthodontic thinkers.

While his co-workers regarded him as an eminent clinical teacher and skilled practitioner, the people of Brookline, Mass., where he lived for many years, regarded him a public-spirited citizen as exemplified by appointing him to positions of trust such as a member of the finance committee and a town meeting member. He also had much to do with town planning and sanitation.

Dr. Howe was, indeed, a worthy product of the New England hills. He was just, wise, ever courteous and ever ready to help a friend or to advance a worthy cause. His broad tolerance and kindly philosophy endeared him not only to generations of students and child patients but also to a host of friends.

News and Notes

Annual Meeting of the American Association of Orthodontists

May 5, 6, 7, 8, 1941

New York City

The annual meeting of the American Association of Orthodontists will be held at the Waldorf-Astoria Hotel, New York City, Monday, Tuesday, Wednesday, and Thursday, May 5 to 8, 1941. All committees are diligently working to make this a real outstanding convention.

The first day of the meeting will be devoted to a golf tournament and trap shoot. The golf tournament will be held at the famous Winged Foot Golf Club, site of the 1940 National Amateur Tournament. For those who have played this course, enough said. For those who have not, a real treat is in store. The trap shoot will be held at the Camp Fire Club, a visit to which will be a grand delight for our riflemen and fly casters.

The scientific program will begin Tuesday morning. Following the address of welcome and President's address the entire day will be devoted to papers and case reports of real practical and scientific value. Among the essayists for this day will be Brig. Gen. Leigh C. Fairbank, who will read a very timely paper on "The Responsibility of the Orthodontist in the Treatment of Traumatic Injuries of the Face and Jaws." At 3:45 P.M. an executive meeting will be held for transaction of business, as prescribed by the Constitution and By-Laws.

Wednesday morning will be devoted to five practical Limited Attendance Clinics. A selection will have to be made as each member will have an opportunity of attending only three of these.

At noon on Wednesday the New York Society of Orthodontists will hold a luncheon meeting for the purpose of election of new members, officers and their installation. They have foregone their regular March meeting this year to concentrate all efforts on helping to make this a meeting which you cannot afford to miss and which will long be remembered.

The afternoon will be devoted to papers and case reports including a symposium which promises to be of unusual interest and value on "Crippled Children and Orthodontics." A short business session is also scheduled for the afternoon at 4:30 o'clock.

On Wednesday evening at 7:30 P.M. the annual banquet and dance will be held in the Grand Ball Room of the Waldorf to be preceded by the President's reception. The entertainment committee is planning to make this a real outstanding social event, plenty of dancing, some good entertainment, but no speeches.

Thursday morning will be given over to papers and just before noon the Albert H. Ketcham Memorial Award will be conferred upon this year's recipient. Following this impressive ceremony the new officers will be installed. In the afternoon some forty-odd table clinics will be held.

Two very valuable additions to the program will be the Scientific and Historic exhibit which will be on display throughout the meeting and the Visual Education Clinics (movies) which will be shown at definite scheduled times on Tuesday, Wednesday, and Thursday.

As usual there will also be a large number of dealers' exhibits, a visit to which will be worth every member's time.

For the ladies attending the meeting an unusually splendid program of entertainment has been arranged; some high lights are luncheons, style show, theater party, and broadcasts.

Questionnaires have been sent to all members, and you are particularly requested to return them filled out at an early date to facilitate the work of the local committees.

We are looking forward to your visit to New York.

HENRY U. BARBER, JR., President.

Western Reserve Dental Alumni Association

The Western Reserve Dental Alumni Association announces its annual alumni day at the School of Dentistry, Monday, June 9, 1941. Dinner and class reunion will be held at the Mid-Day Club at 6:30 P.M.

Harvard Society of Orthodontists

The Annual meeting of the Harvard Society of Orthodontists will be held in Boston, Saturday, May 24, 1941.

Edward I. Silver, Secretary
80 Boylston St., Boston, Mass.

Southern Society of Orthodontists

The next meeting of the Southern Society of Orthodontists will be held in Raleigh, N. C., Sept. 29 and 30, 1941.

Mexican Orthodontists Association

The Third Medico-Dental Convention will be held in Mexico City, June 23 to 28, organized by the Mexican Orthodontists Association, at the School of Dentistry, of the National University of Mexico.

Dr. S. Fastlicht, Secretary
Madero 40, Mexico City, Mexico

Associação Paulista de Cirurgiões Dentistas

The Associacão Paulista de Cirurgiões Dentistas has elected the following officers for the year 1941-1942:

President, Prof. Francisco Degni
Vice-President, Dr. Annibal Fragali
General Secretary, Dr. Francisco Angelo de Moura
First Secretary, Dr. Homero de Souza
Second Secretary, Dr. Hercilio Monteiro de Oliveira
First Treasurer, Dr. Eugenio Langone
Second Treasurer, Dr. Nelson Madureira
Librarian, Dr. Tibor David

Cleveland Dental Society

The Spring Clinic Meeting of the Cleveland Dental Society will be held May 5 to 7, at the Statler Hotel, Cleveland.

American Board of Orthodontics

A meeting of the American Board of Orthodontics will be held at the Waldorf-Astoria Hotel, New York City, Saturday, May 3, 1941.

Orthodontists who desire to obtain certificates of qualifications from the Board should secure necessary application blanks from the secretary. Applications must be presented at least sixty days prior to the meeting. For further information, address the secretary.

Harry E. Kelsey, President
Charles R. Baker, Secretary
636 Church Street, Evanston, Ill.

Denver Summer Seminar

The sixth annual meeting of the Denver Summer Seminar for the study of orthodontics is to be held at the University of Colorado School of Medicine, July 28 to Aug. 2, inclusive. In accordance with Seminar policy to broaden the scope of the meeting and to include new leaders and material, Charles H. Tweed of Tucson, Ariz., and Isaac Schour of the University of Illinois will appear on the program for the first time this year. A prospectus outlining in detail the course of study for the coming meeting will be available in March to all who have specialized in the practice of orthodontics three years or longer. The Denver Summer Seminar is a nonprofit course conducted for practicing orthodontists.

Note of Interest

Dr. Z. Bernard Lloyd announces the opening of an office at 3028 Wisconsin Ave., N. W., Washington, D. C. Practice limited to orthodontics.

Dr. David W. McLean announces the removal of his office to 2585 Huntington Drive, San Marino, Calif.

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, Henry U. Barber, Jr. - - - - 5 East Fifty-Seventh St., New York, N. Y.
Secretary-Treasurer, Max E. Ernst - - - 1250 Lowry Medical Arts Bldg., St. Paul, Minn.
Public Relations Bureau Director, Dwight Anderson
- - - - - - - - - - - - - - - - 292 Madison Ave., New York, N. Y.

Central Association of Orthodontists

President, Harold J. Noyes - - - - - - - - - - 55 E. Washington St., Chicago, Ill.
Secretary-Treasurer, L. B. Higley - - - - - - - - 705 Summit Ave., Iowa City, Iowa

Great Lakes Society of Orthodontists

President, Frank S. Cartwright - - - - - - - - Henry Ford Hospital, Detroit, Mich.
Secretary-Treasurer, Richard E. Barnes - - - - - - - Republic Bldg., Cleveland, Ohio

Harvard Society of Orthodontists

President, I. D. Davis - - - - - - - - - - - - - - 419 Boylston St., Boston, Mass.
Secretary-Treasurer, Edward I. Silver - - - - - - - - 80 Boylston St., Boston, Mass.

New York Society of Orthodontists

President, Glenn F. Young - - - - - - - - - - - 745 Fifth Ave., New York, N. Y.
Secretary-Treasurer, William C. Keller - - - - 40 E. Forty-Ninth St., New York, N. Y.

Pacific Coast Society of Orthodontists

President, Ben L. Reese - - - - - - - - - - - - Roosevelt Bldg., Los Angeles, Calif.
Secretary-Treasurer, Earl F. Lussier - - - - - - 450 Sutter St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, A. B. Brusse - - - - - - - - - - - - - 1558 Humboldt St., Denver, Colo.
Secretary-Treasurer, Robert L. Gray - - - - - - - - - Republic Bldg., Denver, Colo.

Southern Society of Orthodontists

President, Fred G. Hale - - - - - - - - - - - Professional Bldg., Raleigh, N. C.
Secretary-Treasurer, T. C. Sparks - - - - - - - 1508 Washington St., Columbia, S. C.

Southwestern Society of Orthodontists

President, E. Forris Woodring - - - - - - - - - - Medical Arts Bldg., Tulsa, Okla.
Secretary-Treasurer, R. E. Olson - - - - - - - Union Nat'l Bank Bldg., Wichita, Kan.

Washington-Baltimore Society of Orthodontists

President, Paul W. Hoffman - - - - - - - - 1835 Eye St., N. W., Washington, D. C.
Secretary-Treasurer, Stephen C. Hopkins - - - - - 1726 Eye St., Washington, D. C.

American Board of Orthodontics

President, Harry E. Kelsey - - - - - - - - - - - 833 Park Ave., Baltimore, Md.
Vice-President, Frederic T. Murlless, Jr. - - - - 43 Farmington Ave., Hartford, Conn.
Secretary, Charles R. Baker - - - - - - - - - - 636 Church St., Evanston, Ill.
Treasurer, Bernard G. DeVries - - - - - - - Medical Arts Bldg., Minneapolis, Minn.
William E. Flesher - - - - 806 Medical Arts Bldg., Oklahoma City, Okla.
Oliver W. White - - - - - - - - 213 David Whitney Bldg., Detroit, Mich.
James D. McCoy - - - - - - - - 3839 Wilshire Blvd., Los Angeles, Calif.

Foreign Societies†

British Society for the Study of Orthodontics

President, S. A. Riddett
Secretary, R. Cutler
Treasurer, Harold Chapman

*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

†The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis, Mo., U. S. A.